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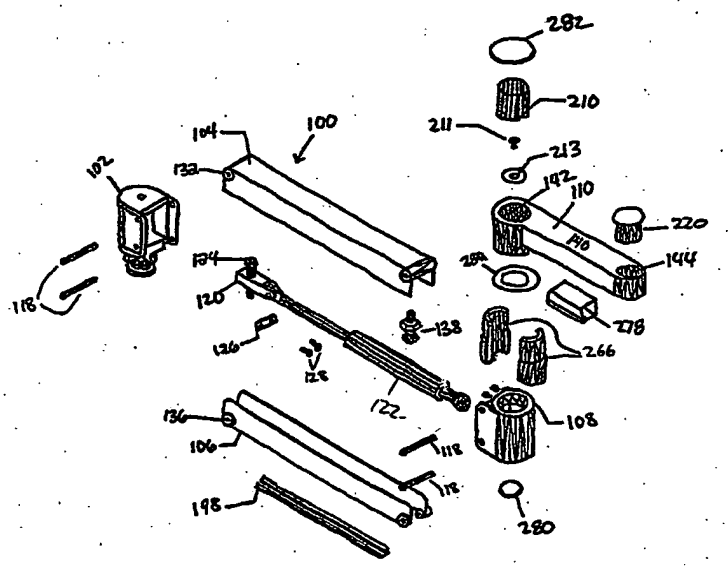
(54) Title: ARM APPARATUS FOR MOUNTING ELECTRONIC DEVICES



(57) Abstract: An extension arm (100) suitable for mounting a flat-screen electronic peripheral device, such as a computer monitor or television, comprises a forearm extension (110) that has at one end a first coupling for attachment to a tilter, a platform or other means for supporting a flat-screen device and at the other end a second coupling with a slot formed therein. The extension arm (100) also comprises a pair of endcaps (102, 108) each having a shaft. The shaft of the first endcap (102) is pivotably rotatable in a support mount, such as a wall, desk or pole mount. The shaft of the second endcap (108) is hollow and is pivotably rotatable in the second coupling of the forearm extension (110). The extension arm (100) also comprises an upper channel (104) and a lower channel (106). Each channel has at opposite ends integrally cast rollers which are pivotably attached to each of the endcaps (102, 108). The lower channel (106) has a cable channel formed therein. The upper and lower channels (104, 106) and the endcaps (102,

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108) form an adjustable parallelogram. The shape of the parallelogram is retained by a gas spring (122), which is attached at a first end to a ball stud mounted in the upper channel (104) and adjustably mounted at a second end to the first endcap (102). A clevis (120) is located within the first endcap (102) and is pivotably attached to the second end of the gas spring (122). A threaded rod (124) threadedly engages the clevis (120), such that the clevis (120) slides within the first endcap (102) when the threaded rod (124) rotates around its axial centerline. A cable from the flat-screen device can be hidden from view by being disposed within the forearm extension (110), the second endcap (108), and the lower channel (106) of the extension arm (100).

ARM APPARATUS FOR MOUNTING ELECTRONIC DEVICES

Field Of The Invention

This invention relates to an arm apparatus for mounting electronic devices, and more specifically to an extension arm suitable to mount a flat-screen electronic peripheral device, such as a computer monitor or a television.

Background Of The Invention

Adjustable extension arms for mounting electronic peripheral devices, such as a computer monitor or a television, are well known in the prior art. Figs. 1-7 illustrate an extension arm 10 for mounting a peripheral device, in accordance with the prior art. As shown in Fig. 1, the main elements of the extension arm 10 are a first endcap 12, an upper channel 14, a lower channel 16, a second endcap 18, and a forearm extension 20.

The first endcap 12 has an endcap shaft 22 that is pivotably attachable to a rigid support mount (not shown), such as an orifice sized to accept the endcap shaft 22 or a track configured and sized to engage the grooves on endcap shaft 22. The first endcap 12 is pivotably coupled via pins 24 to both the upper channel 14 and the lower channel 16. The opposite ends of the upper channel 14 and the lower channel 16 are pivotably coupled via pins 24 to the second endcap 18. The second endcap 18 is coupled to the forearm extension 20 via a forearm extension pin 92. The forearm extension 20 has a vertically disposed hole 26 therethrough for accepting a device

mount (not shown) such as a tilter, platform or other apparatus.

The combination of the upper and the lower channels 14, 16 and the first and the second endcaps 12, 18 form an adjustable parallelogram that permits a device coupled to the forearm extension 20 to be raised and lowered to a desirable height. The parallelogram retains its position by employing a gas spring 28, which is pivotably and adjustably attached to the first endcap 12 and the upper channel 14, as will be further described below. Generally, the gas spring 28 is sized so as to have a fixed length until an upward or downward force is exerted at the second endcap 18 that exceeds the gas spring's designed resistance. Thus, the gas spring 28 causes the parallelogram to retain its position when the only force exerted at the second endcap 18 is the weight of the device, but permits the parallelogram to be adjusted when a user pushes the device coupled to the forearm extension 20 up or down.

Fig. 2 illustrates a side view of the first endcap 12, having the endcap shaft 22 disposed on a first end 30 of the first endcap 12. To provide a rigid connection between the two pieces, the endcap shaft 22 is typically machined from steel and is inserted into the first end 30 during the casting process of the first endcap 12. The endcap shaft 22 has a hole 32 formed in an end of the endcap shaft 22 that is inserted into the first endcap 12. The first endcap 12 is typically fabricated from cast aluminum. The first endcap 12 also has a second end 34 having a hole 36 disposed therethrough. Disposed within the first endcap 12 is a threaded rod 38. A first end

40 of the threaded rod 38 is inserted into the hole 32 at the base of the endcap shaft 22. A second end 42 of the threaded rod 38 is aligned with the hole 36 and is held in place by a clip 44. The clip 44 is fastened to an inner surface of the first endcap 12 by screws 46.

Fig. 3 illustrates a sideview of a clevis 48 which is threadedly mounted on the threaded rod 38. The clevis 48 includes a tapped hole 50 in the center thereof for receiving the threaded rod 38, as shown in Fig. 2. At a first end of the clevis 48 is a pair of fastening members 52, 54 to which are fastened one end of the gas spring 28. A second end 56 of the clevis 48 is configured to slidably engage a track 58 which is integrally molded in the first endcap 12 (see Fig. 2). The second end 42 of the threaded rod 38 is configured to be engaged by a hex-shaped key which is inserted through the hole 36 when the second end 42 is properly aligned with the hole 36. The hex-shaped key is employed so as to rotate the threaded rod 38 along its axis of rotation. When the threaded rod 38 is rotated along its axis of rotation, the clevis 48 moves along the length of the threaded rod 38 in a direction that corresponds to the direction which the hex-shaped key is turned. This movement of the clevis 48 permits the gas spring 28 to be adjusted.

Figs. 4(a) and 4(b) illustrate the upper channel 14, which comprises channel bottom 60 from which extend two channel sidewalls 62. The channel bottom 60 and the sidewalls 62 are typically stamped from 13 gauge steel sheet in order to give the upper channel 14 a desired degree of structural rigidity.

At each of the ends of the channel bottom 60, a semi-circular region 64 of the sidewalls 62 is cut out to accommodate cold-rolled steel rollers 66, which have a hole 68 therethrough for receiving the pins 24. The rollers 66 are rigidly attached to the upper channel 14 by MIG welding along the edge of the semi-circular cut out region 64 and along the ends of the channel bottom 60.

Additionally, the upper channel 14 comprises stiffener 70, which is welded to an inner surface of the channel bottom 60. Besides providing additional structural rigidity to the upper channel 14, the stiffener 70 has a hole disposed at one end with a threaded ball stud 72 placed within the hole and fixed in place by a nut 74. The ball stud 72 is configured and sized to receive one end of the gas spring 28. The longitudinal centerline 76 of the upper channel 14 is illustrated in Fig. 4(b).

Figs. 5(a) and 5(b) illustrate the lower channel 16 which comprises a channel bottom 78 from which extend two channel sidewalls 80. As with the upper channel 14, the channel bottom 78 and the sidewalls 80 are typically stamped from 13 gauge steel sheet, which is relatively heavy in order to give the lower channel 16 a desired degree of structural rigidity. At opposite ends of the channel bottom 78, a semi-circular region 82 of the sidewalls 80 is cut out to accommodate cold-rolled steel rollers 84, which have a hole 86 therethrough for receiving the pins 24. The rollers 84 are rigidly attached to the lower channel 16 by MIG welding along the edge of the semi-circular cut out region 82 and along the ends of the channel

bottom 78. The longitudinal centerline 88 of the lower channel 16 is illustrated on Fig. 5(b).

Fig. 6 illustrates the second endcap 18. Unlike the first endcap 12, the second endcap 18 does not have an endcap shaft, nor does it have a clevis assembly for attachment to the gas spring 28. Instead, the second endcap 18 has a hole 90 disposed in a bottom end for receiving the forearm extension pin 92, and a hole 94 in a side for inserting a pin 96 into the forearm extension pin 92, as illustrated in Fig. 1.

Fig. 7 illustrates the forearm extension 20 having the forearm extension pin 92 welded thereto. The forearm extension pin 92 has a hole 98 formed in an upper end to receive the pin 96. The forearm extension 20 is configured to be pivoted around the forearm extension pin 92, and is held in place within the second endcap 18 by the pin 96 which penetrates the hole 94 of the second endcap 18 and the hole 98 of the forearm extension pin 92.

Due to recent advances in flat-screen technology, there is a demand for adjustable extension arms that are particularly suited for use with flat-screen devices, such as flat-screen computer monitors and televisions. Extension arms 10 of the prior art, such as the one shown in Figs. 1-7 and others like it, are ill-suited for flat-screen monitors and televisions, in that they are bulky and cumbersome. Moreover, due to the configuration of its various parts, extension arms 10 of the prior art cannot be flattened against a mounting surface so that the entire extension arm 10 is hidden behind the flat-screen device when the device is substantially flush with the

mounting surface. Furthermore, the extension arms 10 of the prior art are not designed so as to enable the cables to and from a device to be substantially hidden, and thus protected, within the extension arm 10 itself. Additionally, the extension arms 10 of the prior art are costly to manufacture and difficult to assemble.

Thus, there is a need for an extension arm suitable to mount a flat-screen electronic peripheral device, such as a computer monitor or television, that is inexpensive and easy to manufacture and assemble, and that permits a flat-screen device to be mounted substantially flush with the mounting surface. Moreover, there is a need for an extension arm that enables the cables to and from the flat-screen device to be substantially hidden from view within the extension arm and thus protected from the elements.

Summary Of The Invention

The present invention, in accordance with one embodiment, relates to an extension arm suitable for mounting a flat-screen electronic peripheral device, such as a computer monitor or television. The extension arm is inexpensive and easy to manufacture and assemble, and permits a flat-screen device to be mounted substantially flush with a mounting surface. The extension arm includes a first and a second endcap, an upper and a lower channel, and a forearm extension.

Each endcap includes a body and a shaft. The shaft of the first endcap is pivotably rotatable in a support mount, such as a wall, a desk or a pole mount. The shaft of the second endcap

is rotatably coupled to the forearm extension. The upper channel and the lower channel each have rollers integrally cast at both ends. The rollers are pivotably attached to the respective endcap. The upper and lower channels and the endcaps form an adjustable parallelogram. The shape of the parallelogram is retained by a gas spring. A first end of the gas spring is attached to a ball stud mounted in the upper channel. A second end of the gas spring is adjustably mounted to the first endcap.

The forearm extension is a U-shaped channel with a first coupling disposed at one end for rotatably coupling to a device mount, such as a tilter, a platform or other means for supporting a flat-screen device. The forearm extension has a second coupling disposed at the other end for rotatably coupling to the shaft of the second endcap.

The first endcap also includes a clevis pivotably attached to the second end of the gas spring and a threaded rod threadedly engaging the clevis, such that the clevis slides within the first endcap when the rod rotates around its axial centerline. The threaded rod is rotatably secured within the first endcap by a retainer clip and a pair of screws.

Another embodiment permits cables to be substantially hidden from view by being disposed within the extension arm. The cable is disposed within the lower channel, the second endcap and the forearm extension. The lower channel includes a cable channel formed in a lower surface thereof so that the cable can be inserted within the lower channel. The cable is held in place within the lower channel by a cable cover which

engages the cable channel. The second endcap has a hollow shaft so that the cable can be fed through the shaft to the forearm extension. The second coupling of the forearm extension has a hole in an interior wall so that the cable can be disposed through the hole and into the U-shaped channel. The cable is held within the U-shaped channel by a cable clip.

Brief Description Of The Drawings

The accompanying drawings, which are incorporated in and form a part of the specification, illustrate the embodiments of the present invention and, together with the description, serve to explain the principles of the invention.

Fig. 1 is an assembly drawing of an extension arm for mounting a computer monitor, in accordance with the prior art;

Fig. 2 illustrates a first endcap of an extension arm, in accordance with the prior art;

Fig. 3 illustrates the clevis assembly of an extension arm, in accordance with the prior art;

Figs. 4a and 4b illustrate the upper channel of an extension arm, in accordance with the prior art;

Figs. 5a and 5b illustrate the lower channel of an extension arm, in accordance with the prior art;

Fig. 6 illustrates a second endcap of an extension arm, in accordance with the prior art;

Fig. 7 illustrates a forearm extension of an extension arm, in accordance with the prior art;

Fig. 8 is an exploded assembly drawing of an extension arm, according to one embodiment of the invention;

Figs. 9(a)-(d) illustrate several views of the endcaps of Fig. 8, according to one embodiment of the invention;

Figs. 10 (a)-(f) illustrate several views of the upper channel of Fig. 8, according to one embodiment of the invention;

Figs. 11(a)-(e) illustrate several views of the lower channel of Fig. 8, according to one embodiment of the invention;

Figs. 12(a) and 12(b) illustrate the forearm extension of Fig. 8, according to one embodiment of the invention;

Figs. 13(a) and 13(b) illustrate the forearm extension of Fig. 8, according to one embodiment of the invention;

Fig. 14 is a side view of an extension, according to one embodiment of the invention;

Fig. 15 is an exploded assembly drawing of the extension arm of Fig. 14, according to one embodiment of the invention;

Figs. 16 illustrates the lower channel of Fig. 14, according to one embodiment of the invention;

Figs. 17a-c illustrate several views of the partially enclosed housing of the second endcap of Fig. 14, according to one embodiment of the invention;

Figs. 18a-b illustrates several views of a shaft assembly of the second endcap of Fig. 14, according to one embodiment of the invention;

Fig. 19 illustrates an assembled second endcap according to one embodiment of the invention;

Figs. 20a-b illustrate the forearm extension of Fig. 14, according to one embodiment of the invention; and

Figs. 21a-b, illustrate several views of a bushing used in the second female coupling of the extension arm of Figs. 20a-b, according to one embodiment.

Detailed Description

Of The Preferred Embodiments

In describing the preferred embodiments of the invention illustrated in the drawings, specific terminology will be used for the sake of clarity. However, the invention is not intended to be limited to the specific terms so selected, and it is to be understood that each specific term includes all technical equivalents that operate in a similar manner to accomplish a similar purpose.

With reference to the drawings, in general, and Figs. 8 through 22 in particular, the apparatus of the present invention is disclosed. Embodiments of an extension arm are suitable for mounting a flat-screen electronic peripheral device, such as a computer monitor or television, that is inexpensive and easy to manufacture and assemble, and permits a flat-screen device to be mounted substantially flush with a mounting surface. Additional embodiments can substantially hide from view the cables to and from the flat-screen electronic peripheral device within the extension arm.

Fig. 8 is an exploded assembly drawing of an extension arm 100 in accordance with one embodiment. The extension arm 100 comprises a first endcap 102, an upper channel 104, a lower channel 106, a second endcap 108, and a forearm extension 110.

Figs. 9a and 9b illustrate the first endcap 102 and the

second endcap 108, in accordance with one embodiment of the invention. In the embodiment shown, the first and the second endcaps 102, 108 include a partially-enclosed housing 112 which has flat, oppositely-disposed endwalls 146 and 148 fixedly connected by a sidewall 150. The sidewall 150 extends partially around the partially-enclosed housing 112 so as to permit manipulation of components to be assembled within the first endcap 102. In one embodiment, the endwalls 146 and 148 are semi-circular in shape and are connected along a semi-circular edge to the sidewall 150, which extends perpendicularly therebetween.

Fig. 10a illustrates the first and the second endcaps 102, 108 having a shaft 114 disposed on the endwall 148. The shaft 114 is preferably integrally molded to the endwall 148 of the first and the second endcaps 102, 108. Preferably, the entire first and second endcaps 102, 108 (the partially enclosed housing 112 and the shaft 114) is molded, by for example cast molding, from a material, such as zinc. The shaft 114 is integrally molded with the endcaps 102, 108 by employing interlocking mold technology. Interlocking molds permit a near-perfect mold to be made, minimizing the machining that is required to insure that the shaft 114 is not out-of-round. By minimizing the amount of machining that is required to be performed on the shaft 114, the use of interlocking molds insures that the strength of the casting, which is primarily located in the skin of the cast, is maximized.

Thus, the cost of manufacturing each of the endcaps 102, 108 is reduced significantly. That is, the cost of the steel

shaft 22 and the manufacturing required to separately machine and then insert the steel shaft 22 into the aluminum cast mold of the prior art is reduced. Moreover, the preferred embodiment of using zinc cast mold endcaps 102, 108 (though the present invention is not limited to this embodiment) is an improvement over the aluminum endcaps 12, 18 employed in the prior art as zinc is stronger and more flexible than the aluminum.

The endwall 146 has a hole 152 disposed therethrough. Within the partially enclosed housing 112 and integrally molded on the sidewall 150 are stops 156 disposed in proximity to the endwalls 146, 148; trough walls 158 disposed longitudinally along the inner surface of the sidewall 150 between the endwalls 146 and 148 so as to define a trough 160 therebetween; and shelves 162 disposed adjacent to the endwall 148.

The stops 156 serve to stop upward or downward movement of the extension arm 100 when ends of the upper channel 104 and the lower channel 106, respectively, meet the stops 156 when the extension arm 100 is in extended positions. The trough 160 disposed between the trough walls 158 allows a clevis 120 to be moved therein, as discussed in more detail later. Fig. 10b illustrates the shelves 162 defining co-planar faces separated by a groove 164. The shelves 162 have a connection means, such as self-tapping screw holes 154 disposed therein. The co-planar faces of the shelves 162 are configured to engage a retainer clip 126, which is fastened in place by, for example, a pair of screws 128. When the retainer clip 126 is fastened in place, the groove 164 defines a spacing for accepting one

end of a threaded rod 124, as discussed in more detail below.

The first endcap 102 and the second endcap 108 are identical at this point. That is, unlike the prior art endcaps 12, 18 which are different from each other, the endcaps 102, 108 are advantageously manufactured the same way. Thus, the cost of manufacturing two different kinds of endcaps are eliminated.

The threaded rod 124 and the clevis 120 are now fabricated and assembled in only the first endcap 102. The threaded rod 124 is employed within the first endcap 102 so as to adjustably support the clevis 120. Fig. 9c illustrates the threaded rod 124 having a first end 166 which has a circular cross-section within which is axially disposed a shaped opening 168, for example a hex-shaped opening, for accepting a shaped key (not shown), such as a hex-shaped key. Advantageously, a cross-sectional diameter of the first end 166 is smaller than a cross-sectional diameter of the hole 152, so as to be inserted therein. Adjacent the first end 166 is a shoulder 170. Advantageously, the shoulder 170 has a circular cross-section having a diameter that is larger than the cross-sectional diameter of the hole 152. Thus, in a preferred embodiment, the shoulder 170 abuts an inner surface of the endwall 146 and retains the first end 166 within the hole 152.

The threaded rod 124 also includes a threaded section 172 which is configured to threadedly engage the clevis 120. A second end 174 of threaded rod 124 is disposed in the groove 164 located between the shelves 162 of the first endcap 102. Preferably, the second end 174 of the threaded rod 124 has a

circular cross-section having a diameter that is smaller than the size of the groove 164, such that the second end 174 is supported between the shelves 162 but is free to rotate therein.

As previously mentioned, threadedly mounted on the rod 124 is the clevis 120. The clevis 120 as illustrated in Fig. 9d, has a tapped hole 176 formed therein for receiving the threaded rod 124. The clevis 120 also has a pair of fastening members 178 at a first end to which are fastened a first end of a gas spring 122. The second end of the clevis 120 is configured to slidably engage the trough 160.

When the first end 166 of the threaded rod 124 is engaged by a shaped key, the shaped key is employed so as to rotate the threaded rod 124 around its axial centerline. When the threaded rod 124 is rotated around this axis of rotation, the clevis 120 moves along the length of the threaded rod 124 in a direction that corresponds to the direction which the shaped key is turned. This movement of the clevis 120 permits the gas spring 122 to be adjusted.

The partially enclosed housing 112 of the first and the second endcaps 102, 108 is configured with, for example, holes 116 to receive a connection mechanism, such as pins 118, therethrough. The shaft 114 of the first endcap 102 is configured to be inserted for pivotable rotation in a support mount (not shown), which may be a wall mount, a desk mount, a pole mount, or a configurable mount. The shaft 114 of the second endcap 108 is configured to be inserted for pivotable rotation in the forearm extension 110 which will be described

in more detail later.

The first endcap 102 of the current invention is advantageous to the first endcap 12 of the prior art, and others like it because, for instance, the assembly time required to rotatably fasten the threaded rod 124 in the first endcap 102 is greatly reduced. In order to assemble the threaded rod 124 of the present invention, the first end 166 is inserted into the hole 152 until the shoulder 168 abuts the inner surface of the endwall 146. The second end 174 of the threaded rod 124 is then positioned in the groove 164 between the shelves 162. The second end 174 is held in place by the retainer clip 126 which is fastened in place by, for example, the screws 128, which are easily accessible due to their proximity above the threaded rod 124. The first end 166 of the threaded rod 124 is perfectly aligned with the hole 152, and will remain so, because it is inserted for rotation therein.

By contrast, the assembly of the threaded rod 38 in the first endcap 12 of the prior art is more complicated, and therefore, more costly. For example, the first end 40 is inserted into the hole 32 in the base of the endcap shaft 22. Next, the clevis 48 is mounted on the threaded rod 38, and then the second end 42 is fastened inside the first endcap 12 by the clip 44. The clip 44 is also employed to align the second end 42 relative to the hole 36. Thus, the clip 44 must be fastened inside the first endcap 12 with precision, so as to insure that the second end 42 is aligned relative to the hole 36 such that the second end 42 can be engaged by a hex-shaped key which is inserted into the hole 36. Moreover, the screws 46 which are

employed to the fasten clip 44 inside the first endcap 12 are difficult to access due to their position underneath the threaded rod 38, thus complicating the process of aligning the second end 42 with the hole 36. In addition, the fastening of the clip 44 inside the first endcap 12 is also rendered more difficult because the clevis 48 is already attached to the gas spring 28.

Moreover, unlike the prior art, the current invention does not require a forearm extension pin 92 to connect the second endcap 18 to the forearm extension 20. Moreover, the pin 96 is not required to hold the forearm extension pin 92 within the second endcap 18. Instead, the current invention uses the shaft 114 of the second endcap 108 to connect the second endcap 108 to the forearm extension 110. Thus, manufacturing costs can be reduced since there in no need to manufacture the forearm extension pin 92 or the pin 96, and there is no reason to form the hole 94 within the second endcap 18 or the hole 98 within the forearm extension pin 92 to accept the pin 96.

Figs. 10a-f illustrate several views of the upper channel 104, according to one embodiment of the invention. The upper channel 104 includes a U-shaped body 130 and integrally cast rollers 132 disposed at opposite ends of the U-shaped body 130. The U-shaped body 130 comprises a channel bottom 180 from which extend two channel sidewalls 182. The channel bottom 180, the sidewalls 182 and the rollers 132 of the upper channel 104 are preferably integrally cast from a material, such as zinc, which gives the upper channel 104 a lesser weight, and a degree of structural rigidity, more suitable for lighter-weight flat-

screen devices than the prior art upper channel 14 which is stamped from heavy gauge steel. The rollers 132 have a hole 184 therethrough (either cast or subsequently drilled) for receiving a connection mechanism, such as the pins 118. Additionally, the upper channel 104 comprises a threaded hole 186 configured and sized to receive a threaded end of a ball stud 138. The threaded hole 186 is also integrally cast. The ball stud 138 is configured and sized to receive a second end of the gas spring 122.

Unlike the prior art upper channel 14 in which the U-shaped channel is formed by heating a piece of steel and bending the steel to form the channel bottom 60 and the sidewalls 62, the upper channel 104 of the invention is cast molded. The use of cast molding ensures the angle between the channel bottom 180 and the sidewalls 182 is exactly the same ach and every time. Moreover, cast molding enables the idewalls 182 to be tapered. As illustrated in Figs. 10c and d, both an outer surface and an inner surface of the iewalls 182 may taper in, for example, by approximately 1 ree. It should be noted that the taper is not limited to 1 ree, and that the taper of the inner surface and the outer ace need not be the same.

The taper provides several advantages including more ance between the upper and the lower channels 104, 106 the upper and the lower channels 104, 106 are brought ier during usage. That is, the inner surface of the lls 182 being displaced by 1 degree means that there will tional clearance for the lower channel 106 to fit

therewithin. The additional clearance will help prevent the upper channel 104 and the lower channel 106 from scraping together. Thus, damage to the paint or other coating that may cover the upper and the lower channels 104, 106 will be further reduced, if not eliminated. Moreover, less material is needed at outer edges of the sidewalls 182. Furthermore, the taper is more aesthetically pleasing to the eye of the user.

In a preferred embodiment, as illustrated in Figs. 10e and 10f, the channel bottom 180 includes cross bracing to increase the strength and rigidity of the upper channel 104. The cross bracing may include center ribs 900 and cross ribs 902. The cross bracing increases the rigidity of the upper channel 104 by approximately 1.6 times that of upper channel 104 without the cross bracing.

The upper channel 104 has numerous manufacturing advantages over the upper channel 14 of the prior art, and others like it. For instance, with reference to the upper channel 14 of the prior art shown in Figs. 4a-b, the welding which is required to attach the rollers 66 to the upper channel 14 is difficult to perform. The axial centerlines of the rollers 66 must be near-perfectly parallel to each other, while being near-perfectly perpendicular to the longitudinal centerline 76 of the channel bottom 60. The tolerances for these angles are very small so as to insure that the lower channel 16 engages the upper channel 14 when the parallelogram is adjusted. These tolerances are very difficult to meet when the rollers 66 are welded to the upper channel 14. By contrast, the rollers 132 of the upper channel 104 of the present

invention are integrally cast so as to insure that the axial centerlines of rollers 132 are simultaneously perfectly parallel to each other and perfectly perpendicular to a longitudinal centerline 188 of the channel bottom 180.

Additionally, with further reference to Figs. 4a-b and as previously noted, due to the hardness of the steel employed for the prior art upper channel 14, the rollers 66 must be MIG welded thereto, which in turn requires the rollers 66 to be fabricated from expensive cold-rolled steel. Although it is tempting for a manufacturer of the rollers 66 to employ a cheaper material, such as leadloy, these cheaper materials do not provide a safe and consistent weld when joined to the steel upper channel 14. Typically, tests must be performed on the roller material to insure that leadloy has not been supplied. By contrast, the upper channel 104 of the present invention requires no welding, eliminating the cost of aligning the rollers, the cost of performing the welding and the cost of testing the rollers to determine if they are a suitable welding material.

An additional disadvantage of welding the rollers 66 to the upper channel 14 is that the heat produced by welding the rollers 66 to the upper channel 14 may cause the upper channel 14 to curl or deform. If this occurs, alignment of the rollers 66 is ruined and the upper channel 14 is rendered useless, requiring it to be discarded. By eliminating any welding required during the manufacture of the upper channel 104, the likelihood of heat-deforming the upper channel 104 is also eliminated and materials are not wasted.

As previously mentioned, the prior art upper channel 14 is made of steel, which means that the upper channel 14 is formed by heating a piece of steel and bending the steel to form the channel bottom 60 and the sidewalls 62. Thus, precise manufacturing is required to ensure the sidewalls 62 extend up from the channel bottom 60 at 90 degree angles. If the angle is slightly off it will likely cause the upper channel 14 and the lower channel 16 to scrape against one another. The use of cast molding in the current invention ensures the angle between the channel bottom 180 and the sidewalls 182 is exactly the same each and every time. Thus, the likelihood of scraping is greatly reduced, if not eliminated.

Additionally, the upper channel 104 eliminates the requirement for the stiffener 70, which, with reference to Figs. 4a-b, is welded to the inner surface of the channel bottom 60 in the upper channel 14 of the prior art. Unlike the upper channel 14 of the prior art, the upper channel 104 does not require the additional structural rigidity provided by the stiffener 70. By eliminating the stiffener 70, the upper channel 104 of the present invention also saves the steps required to weld the stiffener 70 to the channel bottom 60 which are required by the prior art upper channel 14.

Moreover, additional assembly steps are saved by integrally casting the threaded hole 186 in the upper channel 104 of the current invention. For instance, the prior art upper channel 14 has the threaded ball stud 72 penetrate a hole disposed in the stiffener 70 and is fixed in place by the nut 74. In order to install the ball stud 72, it is required that

the threaded end of ball stud 72 be inserted through the hole in the stiffener 70 and be fixed in place by the nut 74 prior to the stiffener 70 being welded in place. No such assembly is required with the upper channel 104 of the present invention.

An additional problem experienced by prior art upper channels 14 is the need to mask openings, such as the holes 68 in the rollers 66 that receive the pins 28 therethrough, when the upper channel is painted or otherwise coated. Specifically, labor is required in order to insert masking material into the openings and then to remove the masking material after the paint has been applied. By contrast, the openings of the present invention are according to one embodiment, precision-drilled after an application of paint or other coatings, thus eliminating the expense of masking any openings.

Figs. 11a-e illustrate several views of the lower channel 106, according to one embodiment of the invention. The U-shaped body 134 of the lower channel 106 comprises a channel bottom 190 from which extend two channel side walls 192. Unlike the lower channel 16 of the prior art extension arm shown in Figs. 5a-b, which is stamped from heavy gauge steel, the channel bottom 190 and the sidewalls 192 of the lower channel 106 are preferably integrally cast from zinc, which gives the lower channel 106 a lesser weight when compared to heavy gauge steel, and a degree of structural rigidity, more suitable for lighter-weight flat screen devices. At each end of the channel bottom 180 are the rollers 136, which are also integrally cast. The rollers 136 have a hole 194 therethrough

(either cast or subsequently drilled) for receiving a connection mechanism, such as the pins 118. The channel bottom 190 may additionally include a cable channel aperture 196 running longitudinally. In the embodiment shown, the cable channel aperture 196 has rounded ends, which improves the rigidity of the lower channel 106. The cable channel aperture 196 is configured to receive a cable cover 198 (illustrated in Fig. 11e). The cable cover 198 is configured to removably fit within the cable channel aperture 196. Thus, cables of the mounted device may be substantially retained within the lower channel 106 so as to hide them from view and protect them from harm. The cable channel aperture 196 and the cable cover 198 enable cables to be accessed when desired, while securing them within the lower channel 106.

The lower channel 106 has numerous manufacturing advantages over the lower channel 16 of the prior art, and others like it. For instance, as described above with reference to the upper channel 104, the rollers 136 of the lower channel 106 of the present invention are integrally cast so as to insure that the axial centerlines of the rollers 136 are perfectly parallel to each other, and that the axial centerlines of the rollers 136 are perfectly perpendicular to a longitudinal centerline 200 of the channel bottom 190. Thus, the need for precision alignment of the rollers 84 prior to welding to the lower channel 16 is eliminated.

Additionally, and as also described with reference to the upper channel 104, the rollers 136 of the lower channel 106 are integrally cast so no welding is required. Thus, the cost of

performing the welding and the cost of testing the rollers to determine if they are a suitable welding material is eliminated. Another advantage of eliminating the need for welding the rollers 136 to the lower channel 106 is reducing the likelihood of heat-deforming the lower channel 106 so that materials are not wasted.

As shown in Figs. 11c and 11d, which are cross-sectional views of the lower channel 106, the sidewalls 192 of the lower channel 106 are tapered. As illustrated, an outer surface of the sidewalls 192 is tapered approximately 1/2 degree while an inner surface is tapered approximately 1 degree. As one skilled in the art would recognize, the taper is not limited to the illustrated examples. The taper is possible because the lower channel 106 is, in the preferred embodiment, cast molded. As noted above with respect to the upper channel 104, the taper provides more clearance between the upper channel 104 and the lower channel 106 so as to reduce or eliminate the chance of the upper and the lower channels 104, 106 scraping. Moreover, less material is needed at outer edges of the sidewalls 192.

A further advantage, as noted above with respect to the upper channel 104, is that the hole 194 within the rollers 136, according to one embodiment, is precision-drilled after an application of paint or other coatings, thus eliminating the expense of masking any openings.

As illustrated in Fig. 11e, one embodiment of the cable cover 198 includes a top cover 202 with two sidewalls 204 protruding therefrom. A far end of each sidewall 204 has a catch 206 formed thereon so as to engage with the cable channel

aperture 196. As one skilled in the art would know, numerous other methods are available for removably attaching the cable cover 198 and the cable channel aperture that are well within the scope of the current invention.

With reference to Figs. 12a, 12b, 13a and 13b, the forearm extension 110 includes a body 140, which is preferably U-shaped so that a cable can be hidden therein, having female couplings 142, 144 disposed at each end. The U-shaped body 140 includes a topwall 207 and two side walls 208. The female coupling 142 has an inner diameter 209 that is sized to rotatably engage the shaft 114 of the second endcap 108. As illustrated in Fig. 8, the forearm extension 110 and the shaft 114 are securely fastened to each other by connecting a screw 211 through a coupling top 213 into a hole 215 (Fig. 9a) within the shaft 114.

A bushing 210 (Fig. 8) is preferably used to engage the female coupling 142 and the shaft 114. That is, the bushing 210 is placed over the shaft 114 and within the female coupling 142. The bushing 210 is preferably made of a smooth material, such as plastic, in order to reduce friction and prevent metal to metal contact. The female coupling 142 preferably has a set screw 212 formed within a wall 214 of the female coupling 142. The set screw 212 is aligned to press against the bushing 210 at approximately the location of a ridge 216 (see Fig. 9a) on the shaft 114 of the second endcap 108. When the set screw 212 is tightened it causes the bushing 210 to flex inward and frictionally engage the shaft 114 and thus prevent the forearm extension 110 from rotating about the shaft 114.

Advantageously, the female coupling 142 has a plurality of voids 217 formed in the wall 214, which saves on material costs and permits the forearm extension 110, when cast, to be cooled more quickly. The quicker cooling enables the production quantity to be increased.

The female coupling 144 has an inner diameter 218 that is sized to rotatably engage a shaft of a device mount, such as a tilter, platform or other device used to secure flat-screen devices. A bushing 220 (Fig. 8), preferably made of a smooth material such as plastic, is placed over the shaft and within the female coupling 144. The female coupling 144 preferably has a set screw 222 formed within a wall 224 of the female coupling 144. When the set screw 222 is tightened it causes the bushing 220 to flex inward and frictionally engage the shaft and thus prevent the device mount from rotating around the female coupling 144. Advantageously, the female coupling 144 also has a plurality of voids 226 formed in the wall 224.

Figs. 12a and 12b illustrate one embodiment of the forearm extension 110, wherein the center of the female couplings 142, 144 are aligned with a longitudinal centerline 228 of the body 140. As illustrated in Fig. 12b, when the axial centerlines of the female couplings 142, 144 are vertically disposed, the body 140 inclines at an angle, such as a 15 degree angle as specifically illustrated in Fig. 12b. It should be noted however that the incline angle is not limited to 15 degrees, and there may in fact be no incline at all in this embodiment.

Figs. 13a and 13b illustrate another embodiment of the forearm extension 110, wherein the center of the female

couplings 142, 144 do not align with the axial centerline 228 of the body 140. Rather the body 140 is flush with an upper edge of the female coupling 142, resulting in the center of the female coupling 142 being offset from the center of the female coupling 144. As illustrated in Fig. 13b, when the axial centerlines of the female couplings 142, 144 are vertically disposed, the body 140 is horizontally disposed therebetween. It should be noted however that the body 140 is not limited to be horizontally disposed and may be disposed at an incline in this embodiment.

In addition to improvements in manufacturing and assembly, the present invention also offers a functional interchangeability which is not present in the prior art. For instance, several forearm extensions 110 and/or extension arms 100 can be connected end-to-end to provide additional extension length or additional adjustability.

A dual purpose of flat-screen devices is to minimize the amount of space which they occupy while simultaneously being aesthetically pleasing to the eye. Thus, it is desirable that an extension arm for a flat-screen device be able to be mounted substantially flat to its mounting surface while hiding the extension arm behind it. The present invention permits a flat-screen device which is mounted to a wall to be flattened against the wall while hiding the extension arm 100 within the shadow of the device.

The prior art extension arms 10 did not allow this functionality. Referring to Figure 1, if a wall is defined by the plane of the page, it can be seen that a device inserted

into the hole 26 may be substantially flattened against the wall when the upper and the lower channels 14, 16 and the forearm extension 20 are flush against the wall. A flat-screen computer monitor, which is typically about 15 inches wide, will hide from view the forearm extension 20, but may leave exposed the parallelogram formed by the first endcap 12, the upper channel 14, the lower channel 16 and the second endcap 18. In order to hide the parallelogram, the forearm extension 20 needs to be rotated about the forearm extension pin 92 toward the first endcap 12. However, the upper and the lower channels 14, 16 and the first endcap 12 will prevent the forearm extension 20 from being flush against the wall in this configuration. Thus, it is clear that the prior art extension arms 10 could only provide the ability to mount a device flush to the wall or the ability to mount a device so as to hide the forearm extension 20, but not both.

By contrast, the upper and the lower channels 104, 106 of the present invention do not interfere with the rotation of the forearm extension 110. That is, the forearm extension 110 may be folded into a position which is directly above the upper and the lower channels 104, 106. As a result, the mounted device is flush to the mounting surface and substantially hides the parallelogram, formed by the first and the second endcaps 102, 108 and the upper and the lower channels 104, 106, as well as the forearm extension 110 from view. Thus, the aesthetic appeal of the extension arm 100 is increased and the space occupied by the extension arm 100 and the device is minimized.

In an alternative embodiment, as illustrated in Figs. 14

and 15, the extension arm 100 has a built in cable management system so that cables to and from the device can be hidden within the extension arm 100. In this embodiment, the lower channel 106, the second endcap 108 and the forearm extension 110 are modified as discussed below to permit cables to travel therewithin.

As illustrated in Fig. 16, he cable channel 196 running longitudinally along the channel bottom 190 of the lower channel 106 has a first end 197 that starts near an end of the channel bottom 190 that pivotably connects to the first endcap 102. The cable channel 196 then runs along the entire length of the channel bottom 190 to the end of the channel bottom 190 that pivotably connects to the second endcap 108. Thus, the second end 199 of the cable channel 196 is an opening between the roller 136 at the end of the channel bottom that pivotably connects to the second endcap 108. The first end 197 may be, for example, rounded to improve the rigidity of the lower channel 106. As discussed previously, the cable channel 196 is configured to receive a cable cover 198 (illustrated in Fig. 12e) which is configured to removably fit within the cable channel 196. Thus, cables of the mounted device may be substantially retained within the lower channel 106 so as to hide them from view and protect them from harm. The cable channel 196 and the cable cover 198 enable cables to be accessed when desired, while securing them within the lower channel 106.

As illustrated in Figs. 17a-c, the second endcap 108 includes a partially enclosed housing 250 and a shaft assembly

252. The partially enclosed housing 250 has a first endwall 254 and a second endwall 256 oppositely-disposed from each other and fixedly connected by a sidewall 258. The sidewall 258 extends partially around the partially-enclosed housing 250 so as to permit manipulation of components, such as cables, which may be contained therewithin. The first endwall 254 has a hole 260 disposed therethrough and threaded holes 262 disposed therein that are in communication with the hole 260. Disposed with the threaded holes 262 are set screws 264. Preferably, the diameter of the hole 260 is large enough to allow a plug end of a cable to fit therethrough.

As illustrated in Figs. 18a-c, the shaft assembly 252 preferably includes two symmetrical endcap adapters 266 which when assembled provide a hollow shaft 268. The endcap adapters 266 have a mounting end 270 and a shaft end 272 that is thinner than the mounting end 270. As illustrated in Fig. 19, the mounting end 270 of both of the endcap adapters 266 are inserted into the hole 260 and are coupled together and to the partially enclosed housing 250, to form the second endcap 108, by tightening the set screws 264.

With reference to Figs. 20a-b, the forearm extension 110 includes a body 140 having a first female coupling 142 located on a first end and a second female coupling 144 located on a second end. The first female coupling 142 has an inner diameter 209 that is sized to rotatably engage the hollow shaft 268 of the second endcap 108. The first female coupling 142 is also configured to receive a cable through the hollow shaft 268. That is, the first female coupling 142 has a cable slot

274 formed therein, for example by milling the cable slot 274 into the first female coupling 142, or by casting the first female coupling 142 with the cable slot 274 integrally formed therein. As illustrated in Figs. 21a-b, the bushing 210 also has a cable slot 276 formed therein. The cable slots 274, 276 are aligned so that a cable can pass therethrough.

Referring back to Fig. 14, a flat screen monitor 300 is attached to a tilter 302 which is rotatably coupled to the second female coupling 144. A cable 304, such as a power cable, proceeds from the monitor 300 to the underside off the U-shaped body 140 of the forearm extension 110. The cable 304 is held in place within the U-shaped body 140 by the cable holder 278. The cable 304 proceeds from the body through the cable slots 274, 276 in the bushing 210 and the first female coupling 142. The cable then proceeds through the hollow shaft 268 of the second endcap 108. The cable exits the second endcap 208 through the open end of the partially enclosed housing 260. The cable proceeds down the length of the lower channel 106 and exits at the first end 197 of the cable channel 196.

Preferably, the cable 304 is inserted into the extension arm 100 as portions of the extension arm 100 are being assembled. That is, the cable 304 is placed under the U-shaped body 140 of the forearm extension 110 and is held in place by the cable holder 278. The cable is then passed through the cable slots 274, 276. The cable 304 including the plug 306 is then fed through the hole 260 in the second endcap 108. The second endcap 108 is now assembled by inserting the mounting

Claims

What is claimed is:

1. An extension arm for adjustably mounting a device to a support mount, said extension arm comprising:

a forearm extension having a first end for attachment to the device and a second end;

a first endcap including a first endcap body and a first endcap shaft, said first endcap shaft pivotably attached to the support mount;

a second endcap including a second endcap body and a second endcap shaft, said second endcap shaft pivotably attached to the second end of said forearm extension;

an upper channel having a first end, a second end, a first roller disposed on the first end and configured to be pivotably attached to said first endcap, and a second roller disposed on the second end and configured to be pivotably attached to said second endcap;

a lower channel having a first end, a second end, a third roller disposed on the first end and configured to be pivotably attached to said first endcap, and a fourth roller disposed on the second end and configured to be pivotably attached to said second endcap; and

a gas spring rotatably attached at a first end to said upper channel and adjustably attached at a second end to said first endcap, wherein said gas spring is configured to retain said upper channel, said lower channel, said first endcap and said second endcap in a parallelogram shape when the device is positioned.

end 270 of each endcap adapter 268 into the hole 260, thus surrounding the cable 304. The endcap adapters 268 are held together and within the hole 260 by tightening the set screws 264. The hollow shaft 268 is then placed within the first female coupling 142. The cable 304 is placed within the lower channel 106, prior to the lower channel 106 and the second endcap being secured together. This ensures that the cable 304 is above the roller 136 and is contained within the hollow bar formed by the upper channel 104 and the lower channel 106.

Referring back to Fig. 15, several additional components of the extension arm 100 are discussed. For aesthetic purposes, a bumper 280 may be placed on the second endwall 256 of the second endcap 108 and a plug 282 may be placed over the first female coupling 142. A washer 284 may be placed over the two endcap adapters 268 to help secure them together.

Although this invention has been illustrated by reference to specific embodiments, it will be apparent to those skilled in the art that various changes and modifications may be made that clearly fall within the scope of the invention. The invention is intended to be protected broadly within the spirit and scope of the appended claims.

2. The extension arm of claim 1, wherein all of said rollers of said upper channel are integrally cast with said upper channel so as to be an integral part of said upper channel and all of said rollers of said lower channel are integrally cast with said lower channel so as to be an integral part of said lower channel.

3. The extension arm of claim 1, wherein said first endcap further includes:

a clevis pivotably attached to the second end of said gas spring; and

a rod in threaded engagement with said clevis, wherein said clevis is configured to slide within said first endcap when said rod rotates around its axial centerline.

4. The apparatus according to claim 3, wherein said first endcap body has a hole formed in a side thereof and a first end of said rod is inserted through said hole.

5. The extension arm of claim 4, wherein the first end of said rod has a shaped opening and is configured to rotate around its axis when a shaped key is inserted in said shaped opening and is turned.

6. The extension arm of claim 5, wherein said rod has a shoulder adjacent to the first end, said shoulder having a diameter larger than a diameter of said hole in said first

endcap body so that said shoulder abuts an inner surface of said first endcap body and retains the first end of said rod in said hole.

7. The extension arm of claim 6, wherein said first endcap further includes a pair of shelves disposed in said first endcap body adjacent to the first end, said pair of shelves separated by a groove.

8. The extension arm of claim 7, wherein each of said pair of shelves includes a self tapping screw hole disposed therein.

9. The extension arm of claim 8, wherein a second end of said rod is rotatably secured within said groove in said first endcap, and is retained in place by a retainer clip fastened to said shelves.

10. The extension arm of claim 1, wherein said upper channel has a threaded hole formed therein.

11. The extension arm of claim 10, wherein the second end of said gas spring is rotatably mounted to said upper channel via a ball stud threadedly mounted in said threaded hole in said upper channel.

12. The extension arm of claim 10, wherein said threaded hole is integrally cast with said upper channel so as to be an

integral part of said upper channel.

13. The extension arm of claim 1, wherein said first end cap and said second endcap are fabricated from a zinc material.

14. The extension arm of claim 1, wherein said first endcap and said second endcap are cast molded.

15. The extension arm of claim 1, wherein said first endcap and said second endcap are made via interlocking molding.

16. The extension arm of claim 1, wherein the device is a flat-screen device.

17. The extension arm of claim 16, wherein said extension arm is configured so as to be substantially hidden behind the flat-screen device when the flat-screen device is positioned flat against a mounting surface.

18. The extension arm of claim 1, wherein a lower surface of said lower channel has a cable channel aperture formed therein.

19. The extension arm of claim 1, wherein said first endcap body and said second endcap body further include stops located therein, the stops located proximate to a first end and a second end.

20. The extension arm of claim 1, wherein said first endcap body and said second endcap body further include a pair of trough walls therein, the pair of trough walls forming a trough therebetween.

21. The extension arm of claim 1, wherein said upper channel, said lower channel, said first endcap and said second endcap are pivotably attached in such a manner that said first endcap shaft and said second endcap shaft face opposite directions.

22. An extension arm for adjustably mounting a device to a support mount, said extension arm comprising:

a forearm extension having a first end for attachment to the device and a second end;

a first endcap pivotably attached to the support mount;

a second endcap pivotably attached to the second end of said forearm extension;

an upper channel having a first roller at a first end and a second roller at a second end, wherein said rollers are integrally cast with said upper channel, said first roller configured to be pivotably attached to said first endcap and said second roller configured to be pivotably attached to said second endcap;

a lower channel having a third roller at a first end and a fourth roller at a second end, wherein said rollers are integrally cast with said lower channel, said third roller

configured to be pivotably attached to said first endcap and said fourth roller configured to be pivotably attached to said second endcap; and

a gas spring rotatably attached at a first end to said upper channel and adjustably attached at a second end to said first endcap, wherein said gas spring is configured to retain said channels and said endcaps in a parallelogram shape when the device is positioned.

23. The extension arm of claim 22, wherein a lower surface of said lower channel has a cable channel aperture formed therein.

24. The extension arm of claim 23, further comprising a cover that is removably attachable to said cable channel aperture.

25. The extension arm of claim 22, wherein said first endcap includes a first endcap body and a first endcap shaft, said first endcap shaft pivotably attached to the support mount, and said second endcap includes a second endcap body and a second endcap shaft, said second endcap shaft pivotably attached to the second end of said forearm extension.

26. The extension arm of claim 22, wherein said upper channel has a threaded hole formed therein.

27. The extension arm of claim 26, wherein the second end

of said gas spring is rotatably mounted to said upper channel via a ball stud threadedly mounted in said threaded hole in said upper channel.

28. The extension arm of claim 26, wherein said threaded hole is integrally cast with said upper channel so as to be an integral part of said upper channel.

29. An endcap for use in an extension arm that adjustably mounts a device to a support mount, said endcap comprising:

a partially enclosed housing having a first endwall, a second endwall and at least one sidewall, said first endwall having a hole contained therein;

a shaft connected to said second endwall; and

a pair of shelves disposed within said partially enclosed housing adjacent to said second endwall, said pair of shelves forming a groove therebetween.

30. The endcap of claim 29, further comprising stops located within said partially enclosed housing proximate to said first endwall and said second endwall.

31. The endcap of claim 29, further compromising a pair of trough walls formed within said partially enclosed housing, said pair of trough walls forming a trough therebetween.

32. The endcap of claim 29, further compromising:

a clevis having a hole therein;

a rod in threaded engagement with said clevis, wherein said clevis is configured to slide within said endcap when said rod rotates around its axial centerline.

33. The endcap of claim 32, wherein said rod includes a first end having a shaped opening, a shoulder adjacent to the first end, a threaded portion, and a second end.

34. The endcap of claim 33, wherein the first end of said rod is located within said hole in said first endwall, and said shoulder of said rod abuts an inner surface of said first endwall.

35. The endcap of claim 33, wherein said rod is configured to rotate around its axis when a shaped key is inserted in said shaped opening and is turned.

36. The endcap of claim 33, wherein the second end of said rod is rotatably secured within said groove and is retained in place by a retainer clip fastened to said shelves.

37. The endcap of claim 29, wherein said partially enclosed housing, said shaft, and said pair of shelves are fabricated from a zinc material.

38. The endcap of claim 29, wherein said partially enclosed housing, said shaft and said pair of shelves are cast molded.

39. The endcap of claim 29, wherein said partially enclosed housing, said shaft and said pair of shelves are made via interlocking molding.

40. An upper channel for use in an extension arm that adjustably mounts a device to a support mount, said upper channel comprising a body having a first roller at a first end and a second roller at a second end, wherein said body and said rollers are integrally cast.

41. The upper channel of claim 40, wherein said body includes a threaded hole formed therein.

42. The upper channel of claim 41, wherein said threaded hole is integrally cast with said body and said rollers.

43. The upper channel of claim 41, further comprising a ball stud threadedly mounted to said threaded hole.

44. The upper channel of claim 40, wherein said body and said rollers are fabricated from a zinc material.

45. The upper channel of claim 40, wherein said body and said rollers are cast molded.

46. The upper channel of claim 40, wherein said body and said rollers are made via interlocking molding.

47. A lower channel for use in an extension arm that adjustably mounts a device to a support mount, said lower channel comprising a body having a first roller at a first end and a second roller at a second end, wherein said body and said rollers are integrally cast.

48. The lower channel of claim 47, wherein a lower surface of said body has a cable channel aperture formed therein.

49. The lower channel of claim 48, further comprising a cover that is removably attachable to said cable channel aperture.

50. The lower channel of claim 47, wherein said body and said rollers are fabricated from zinc material.

51. The lower channel of claim 47, wherein said body and said rollers are cast molded.

52. The lower channel of claim 47, wherein said body and said rollers are made via interlocking molding.

53. A method of forming an extension arm that adjustably mounts a device to a support mount, the method comprising:

forming an upper channel that includes a roller at each end and a threaded hole therein;

forming a lower channel that includes a roller at each end;

forming two identical endcaps having

a partially enclosed housing having a first endwall, a second endwall and at least one sidewall, wherein the first endwall contains a hole therein, and the second endwall has a shaft connected thereto, and

a pair of shelves disposed within the partially enclosed housing near the second endwall, the pair of shelves forming a groove therebetween;

forming a rod including a fist end having a shaped opening, a shoulder adjacent to the first end, a threaded portion, and a second end;

threading the rod through a hole in a clevis;

placing the first end of the rod within the hole in the first endwall of a first one of the endcaps until the shoulder abuts an inner surface of the first endwall;

placing the second end of the rod within the groove in the first endcap;

securing the second end of the rod by placing a retainer over the rod and connecting the retainer to the shelves;

forming a forearm extension having a body, a first end for connecting to a second one of the endcaps and a second end for connecting to the device;

threadedly mounting a ball stud in the threaded hole of the upper channel;

connecting one end of a gas spring to the ball stud and a second end of the gas spring to a fastening member of the

clevis;

attaching the upper channel, the lower channel, the first endcap and the second endcap to form a parallelogram; and

connecting the first end of the forearm extension and the shaft of the second endcap.

54. The method of claim 53, wherein the upper channel, the lower channel, the first endcap and the second endcap are attached in a manner such that the shaft of the first endcap and the shaft of the second endcap face opposite directions.

55. The method of claim 53, wherein said forming an upper channel includes integrally casting the upper channel including the rollers and the threaded hole contained therein.

56. The method of claim 55, wherein said integrally casting the upper channel includes integrally casting the upper channel from zinc.

57. The method of claim 53, wherein said forming a lower channel includes integrally casting the lower channel including the rollers.

58. The method of claim 57, wherein said integrally casting the lower channel includes integrally casting the lower channel from zinc.

59. The method of claim 53, wherein said forming a lower

channel includes forming a lower channel with a roller at each end and a cable channel aperture in a lower surface.

60. The method of claim 59, further comprising placing a cover within the cable channel aperture.

61. The method of claim 53, wherein said forming two identical endcaps includes integrally casting the two identical endcaps including the partially enclosed housing, the shaft, and the pair of shelves disposed within the partially enclosed housing.

62. The method of claim 61, wherein said integrally casting the two identical endcaps includes integrally casting the two identical endcaps from zinc.

63. A method of forming an extension arm that adjustably mounts a device to a support mount, the method comprising:

integrally casting an upper channel that includes a roller at each end and a threaded hole contained therein;

integrally casting a lower channel that includes a roller at each end;

forming a first endcap including a clevis;

forming a second endcap;

forming a forearm extension having a body, a first end for connecting to the second endcap and a second end for connecting to the device;

threadedly mounting a ball stud in the threaded hole of

the upper channel;

connecting one end of a gas spring to the ball stud and a second end of the gas spring to a fastening member of the clevis;

attaching the upper channel, the lower channel, the first endcap and the second endcap to form a parallelogram; and

connecting the first end of the forearm extension and the second endcap.

64. The method of claim 63, wherein said forming the first endcap includes

forming a partially enclosed housing having a first endwall, a second endwall and at least one sidewall, wherein the first endwall contains a hole therein, and the second endwall has a shaft connected thereto;

forming a pair of shelves disposed within the partially enclosed housing near the second endwall, the pair of shelves forming a groove therebetween;

forming a rod including a fist end having a shaped opening, a shoulder adjacent to the first end, a threaded portion, and a second end;

threading the rod through a hole in the clevis;

placing the first end of the rod within the hole in the first endwall until the shoulder abuts an inner surface of the first endwall;

placing the second end of the rod within the groove; and

securing the second end of the rod by placing a retainer over the rod and connecting the retainer to the shelves.

65. The method of claim 63, wherein said forming the second endcap includes

forming a partially enclosed housing having a first endwall, a second endwall and at least one sidewall, wherein the first endwall contains a hole therein, and the second endwall has a shaft connected thereto; and

forming a pair of shelves disposed within the partially enclosed housing near the second endwall, the pair of shelves forming a groove therebetween.

66. The method of claim 63, wherein said integrally casting the upper channel includes integrally casting the upper channel from zinc.

67. The method of claim 63, wherein said integrally casting the lower channel includes integrally casting the lower channel from zinc.

68. The method of claim 63, wherein said forming a lower channel includes forming the lower channel with the roller at each end and a cable channel aperture in a lower surface.

69. The method of claim 63, further comprising placing a cover within the cable channel aperture.

70. A method of forming endcaps for use in an extension arm that adjustably mounts a device to a support mount, the

method comprising forming two partially enclosed housings, each housing having a first endwall with a hole formed therein, a second endwall with a shaft connected thereto, at least one sidewall, and a pair of shelves disposed within the partially enclosed housing adjacent to the second endwall, the pair of shelves forming a groove therebetween.

71. The method of claim 70, further comprising

forming a rod including a fist end having a shaped opening, a shoulder adjacent to the first end, a threaded portion, and a second end;

threading the rod through a hole in a clevis;

placing the first end of the rod within the hole in the first endwall of a first one of the partially enclosed housings until the shoulder abuts an inner surface of the first endwall;

placing the second end of the rod within the groove in the first one of the partially enclosed housings; and

securing the second end of the rod by placing a retainer over the rod and attaching the retainer to the shelves.

72. The method of claim 70, wherein said forming two partially enclosed housings includes integrally casting the two partially enclosed housings including the endwalls, the shaft, the at least one sidewall, and the pair of shelves.

73. The method of claim 72, wherein said integrally casting the two partially enclosed housings includes integrally casting the two partially enclosed housings from zinc.

74. The method of claim 70, wherein said forming two partially enclosed housings includes forming the two partially enclosed housings each having stops located within the partially enclosed housings adjacent to the first endwall and the second endwall.

75. The method of claim 70, wherein said forming two partially enclosed housings includes forming the two partially enclosed housings each having a pair of trough walls within the partially enclosed housings, the pair of trough walls forming a trough therebetween.

76. A method of forming channels for use in an extension arm that adjustably mounts a device to a support mount, the method comprising:

integrally casting an upper channel that includes a roller at each end and a threaded hole formed therein; and

integrally casting a lower channel that includes a roller at each end.

77. The method of claim 76, wherein said integrally casting the upper channel includes integrally casting the upper channel from zinc.

78. The method of claim 76, wherein said integrally casting the lower channel includes integrally casting the lower channel from zinc.

79. The method of claim 76, wherein said integrally casting a lower channel includes integrally casting the lower channel with the rollers and a cable channel aperture in a lower surface.

80. The method of claim 79, further comprising placing a cover within the cable channel aperture.

81. The method of claim 76, further comprising threadedly mounting a ball stud in the threaded hole of the upper channel.

82. An extension arm for adjustably mounting a device to a support mount and hiding cables to and from the device within said extension arm, said extension arm comprising:

a forearm extension having a body, means for attachment to the device disposed at a first end of said body, and a coupling disposed at a second end, said second end coupling having a cable slot formed in a wall thereof so that said second end coupling and said body are in communication with each other through said cable slot;

a first endcap including a support shaft pivotably attached to the support mount;

a second endcap including a partially enclosed housing and a hollow shaft, said hollow shaft pivotably attached to said second end coupling;

an upper channel having a first roller disposed at a first end and configured to be pivotably attached to said first

endcap, and a second roller disposed at a second end and configured to be pivotably attached to said second endcap;

a lower channel having a third roller disposed at a first end and configured to be pivotably attached to said first endcap, a fourth roller disposed at a second end and configured to be pivotably attached to said second endcap, and a cable channel formed therein that runs longitudinally along said lower channel from a point close to the first end of said lower channel to the second end of said channel so as to cut through said fourth roller and form an opening in the second end of said lower channel; and

a gas spring rotatably attached at a first end to said upper channel and adjustably attached at a second end to said first endcap, wherein said gas spring is configured to retain said upper channel, said lower channel, said first endcap and said second endcap in a parallelogram shape when the device is positioned.

83. The extension arm of claim 82, wherein a cable from the device is disposed within said extension arm starting at said body of said forearm extension and proceeding through said cable slot into said second end coupling, through said second end coupling into said hollow shaft, through said hollow shaft into said partially enclosed housing, through said partially enclosed housing into said lower channel, and through said lower channel exiting at a starting point of said cable channel.

84. The extension arm of claim 82, wherein said upper channel, said lower channel, said first endcap and said second endcap are pivotably attached in such a manner that said support shaft and said hollow shaft face opposite directions.

85. The extension arm of claim 82, further comprising a cable cover that is removably attachable to said cable channel.

86. The extension arm of claim 82, wherein said partially enclosed housing includes a first endwall, a second endwall and at least one sidewall, said first endwall having a endwall hole contained therein.

87. The extension arm of claim 82, wherein said hollow shaft includes two symmetrical endcap adapters connected together.

88. The extension arm of claim 87, wherein each of said symmetrical endcap adapters have a semicircular cross sectional profile.

89. The extension arm of claim 86, wherein said hollow shaft has a portion with a first diameter and a portion with a second diameter that is greater than the first diameter.

90. The extension arm of claim 89, wherein the second diameter of said hollow shaft is nearly the same as a diameter of said endwall hole.

91. The extension arm of claim 89, wherein said portion of said hollow shaft with the second diameter is inserted into said endwall hole.

92. The extension arm of claim 86, wherein said first endwall further includes threaded holes that are in communication with said endwall hole.

93. The extension arm of claim 92, further comprising fasteners that are inserted in said threaded holes so as to couple said hollow shaft and said partially enclosed housing.

94. The extension arm of claim 86, wherein said endwall hole is large enough so a plug of a cable can fit therethrough.

95. A second endcap for use in an extension arm that adjustably mounts a device to a support mount and hides cables to and from the device within said extension arm, said second endcap comprising:

a partially enclosed housing having a first endwall, a second endwall and at least one sidewall, said first endwall having a endwall hole contained therein; and

a shaft assembly having a shaft hole therethrough, said shaft assembly connected to said first endwall so that said shaft hole and said endwall hole are aligned so as to form a continuous hole.

96. The second endcap of claim 95, wherein said shaft assembly includes two symmetrical endcap adapters connected together to form a hollow shaft.

97. The second endcap of claim 96, wherein each of said symmetrical endcap adapters have a semicircular cross sectional profile.

98. The second endcap of claim 95, wherein said hollow shaft has a portion with a first diameter and a portion with a second diameter that is greater than the first diameter.

99. The second endcap of claim 98, wherein the second diameter of said hollow shaft is nearly the same as a diameter of said endwall hole.

100. The second endcap of claim 98, wherein said portion of said hollow shaft with the second diameter is inserted into said endwall hole.

101. The second endcap of claim 95, wherein said first endwall further includes threaded holes that are in communication with said endwall hole.

102. The second endcap of claim 101, further comprising fasteners that are inserted in said threaded holes so as to couple said shaft assembly and said partially enclosed housing.

103. The second endcap of claim 95, wherein said endwall hole is large enough so a plug of a cable can fit therethrough.

104. The second endcap of claim 95, wherein said at least one sidewall is semicircular in shape and connects to said first endwall and said second endwall.

105. The second endcap of claim 95, wherein said second endcap is fabricated from a zinc material.

106. The second endcap of claim 95, wherein said second endcap is cast molded.

107. The second endcap of claim 95, wherein said second endcap is manufactured via interlocking molding.

108. A lower channel for use in an extension arm that adjustably mounts a device to a support mount and hides cables to and from the device within said extension arm, said lower channel comprising:

a body;

a first roller disposed at a first end of said body;

a second roller disposed at a second end of said body; and

a cable channel formed therein that runs longitudinally along said lower channel from a point close to the first end of said lower channel to the second end of said channel so as to cut through said second roller and form an opening in the second end of said lower channel.

109. The lower channel of claim 108, further comprising a cable cover that is removably attachable to said cable channel.

110. The lower channel of claim 108, wherein said lower channel is fabricated from zinc material.

111. The lower channel of claim 108, wherein said lower channel is cast molded.

112. The lower channel of claim 108, wherein said lower channel is manufactured via interlocking molding.

113. A forearm extension for use in an extension arm that adjustably mounts a device to a support mount and hides cables to and from the device within said extension arm, said forearm extension compromising:

a body;

means for attachment to the device disposed at a first end of said body; and

a coupling disposed at a second end, said second end coupling having a slot formed in a wall thereof so that said coupling and said body are in communication with each other through said slot.

114. The forearm extension of claim 113, wherein said second end coupling has a set screw contained in a sidewall.

115. The forearm extension of claim 113, wherein an inner surface of said second end coupling has a plurality of grooves formed therein.

116. The forearm extension of claim 113, wherein said means for attachment is a first end coupling.

117. The forearm extension of claim 116, wherein said first end coupling has a set screw contained in a sidewall.

118. The forearm extension of claim 116, wherein an inner surface of said first end coupling has a plurality of grooves formed therein.

119. The forearm extension of claim 113, wherein said body is U-shaped.

120. The forearm extension of claim 119, further compromising a cable holder within said U-shaped body.

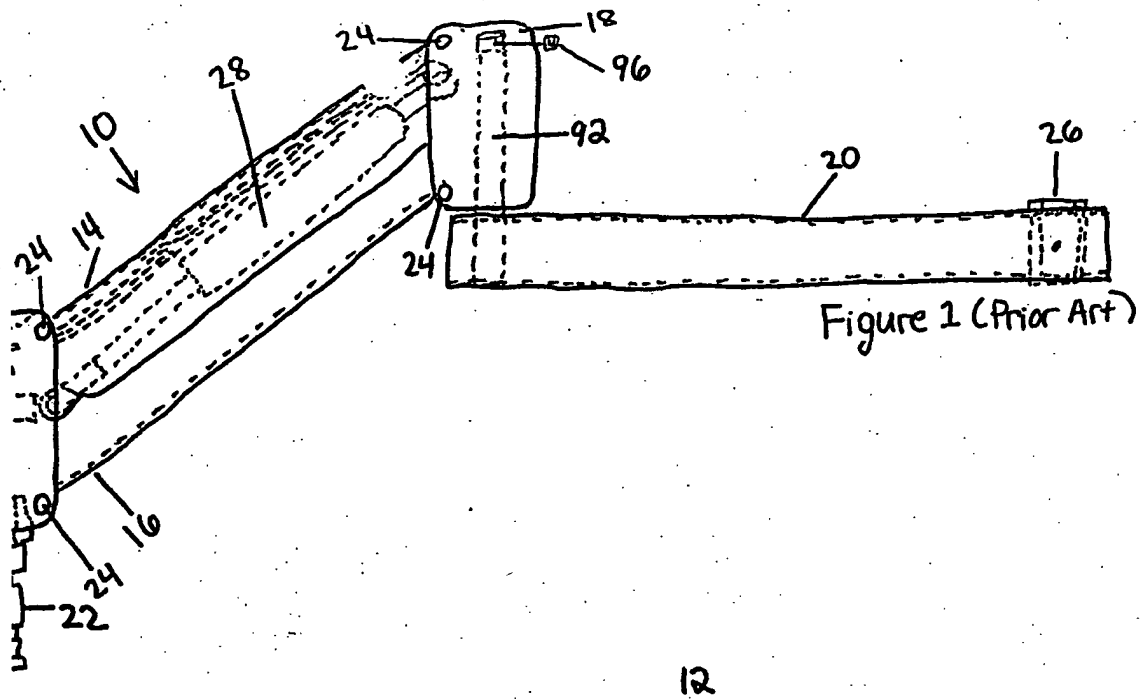

Figure 1 (Prior Art)

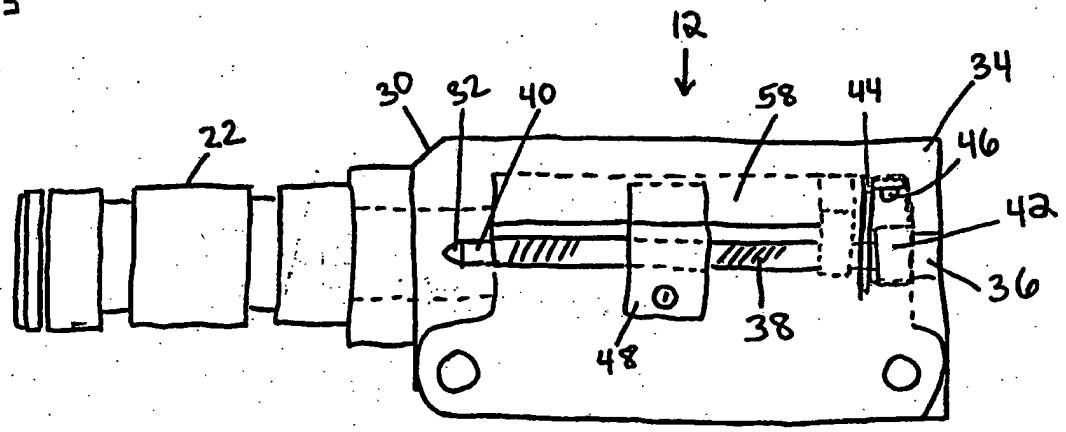

Figure 2 (Prior Art)

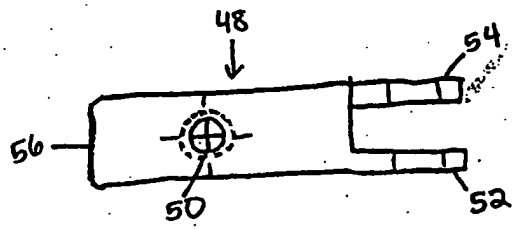

Figure 3 (Prior Art)

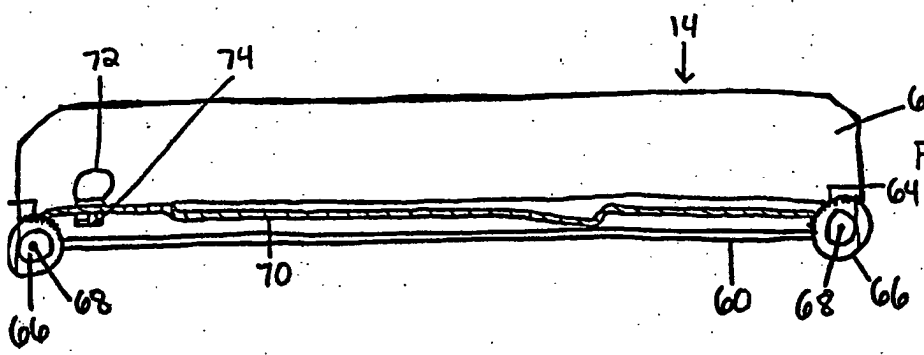

Figure 4a (Prior Art)

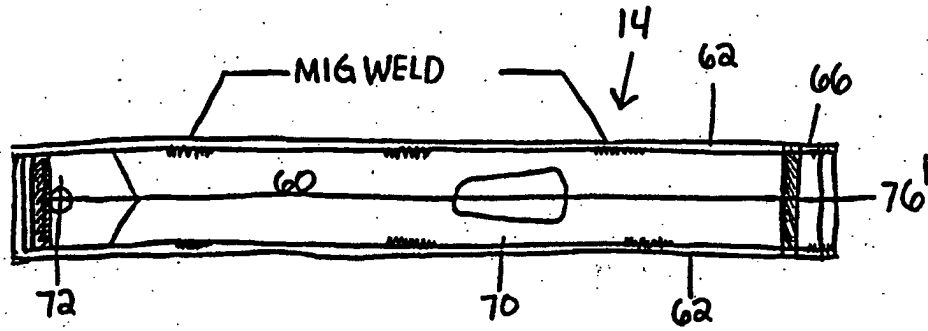

Figure 4b (Prior Art)

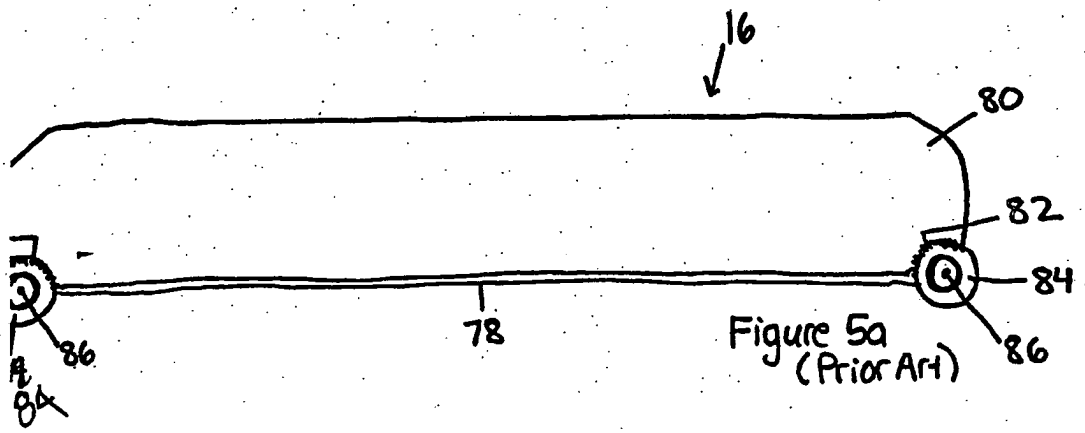

Figure 5a (Prior Art)

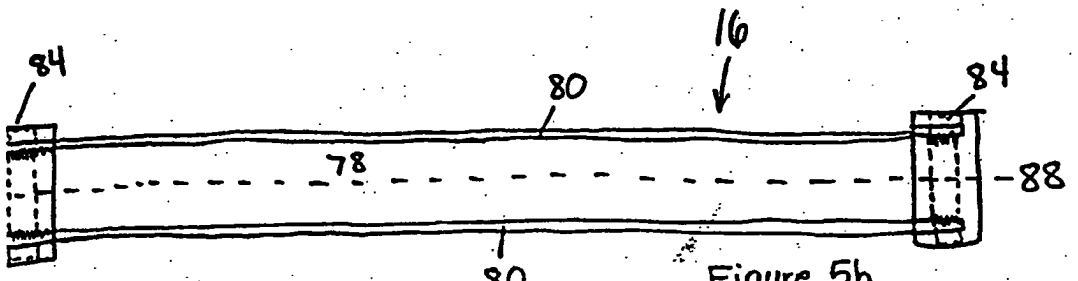

Figure 5b (Prior Art)

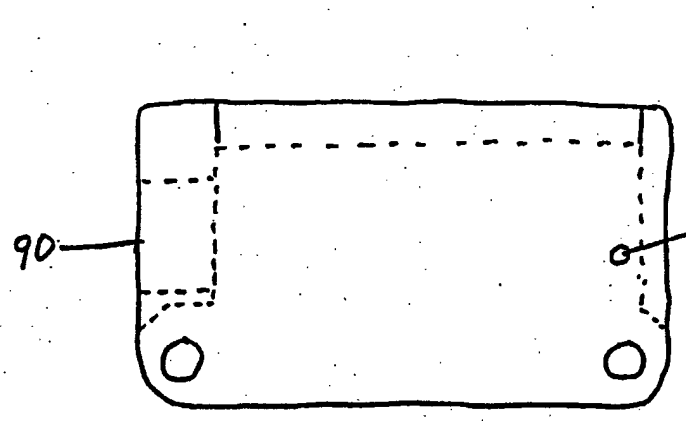

Figure 6 (Prior Art)

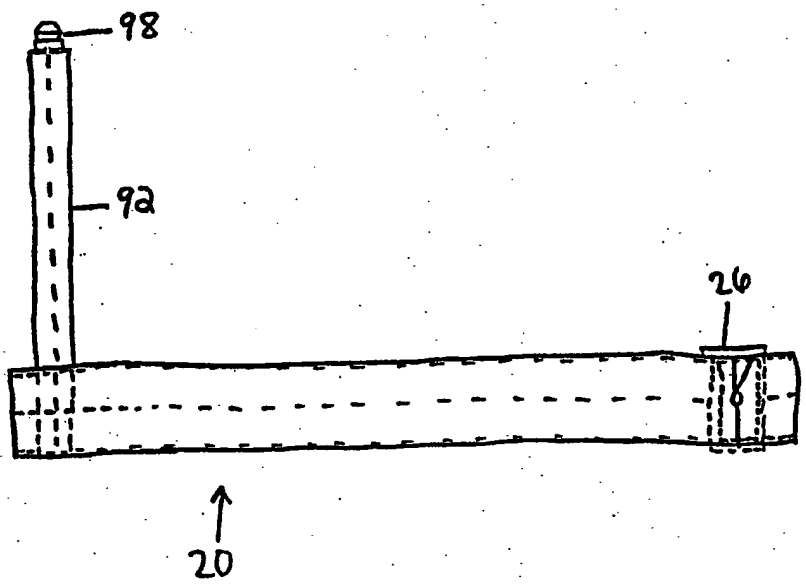

Figure 7 (Prior Art)

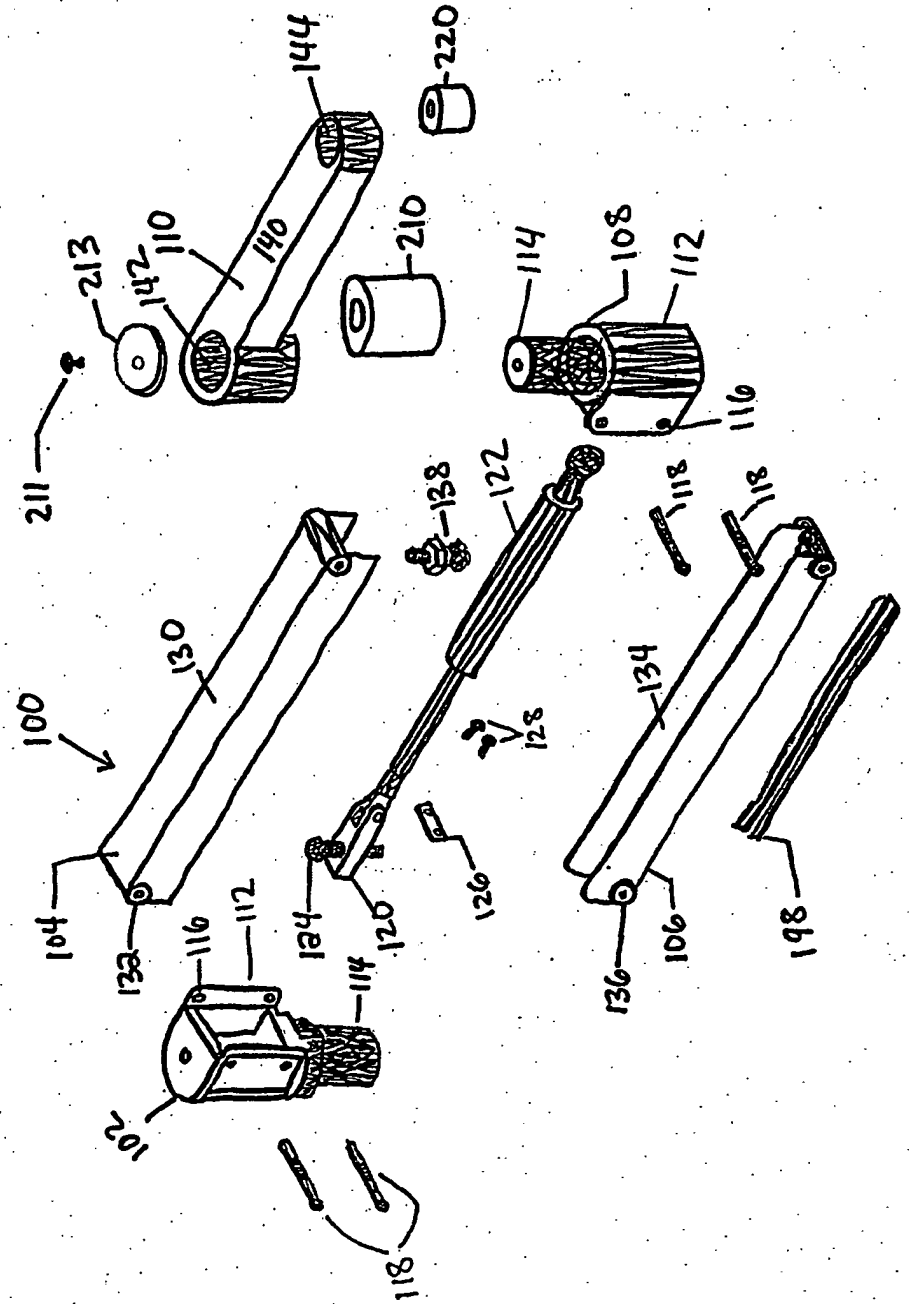

Figure 8

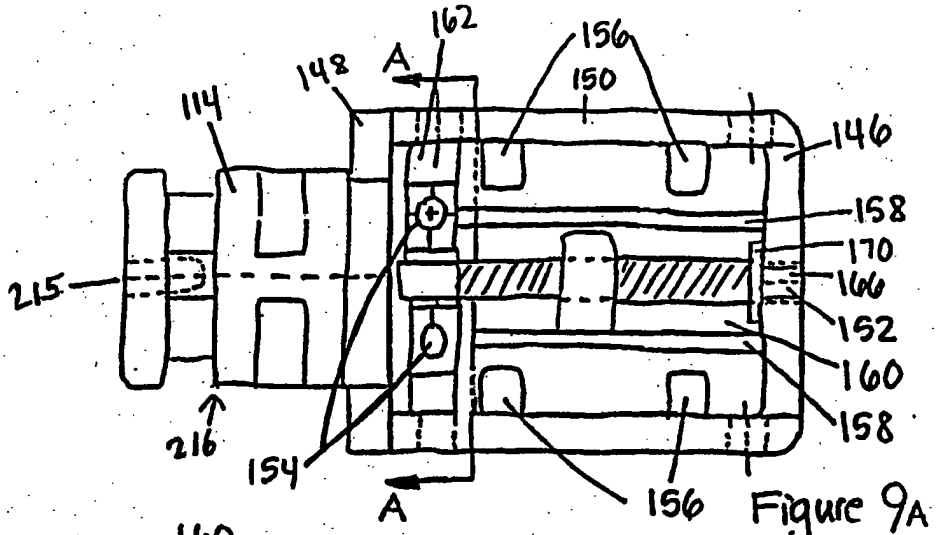

Figure 9A

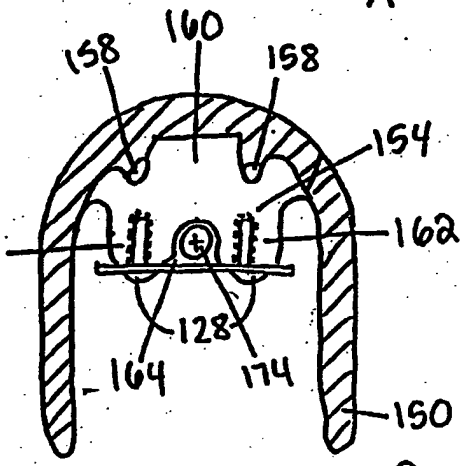

Figure 9B

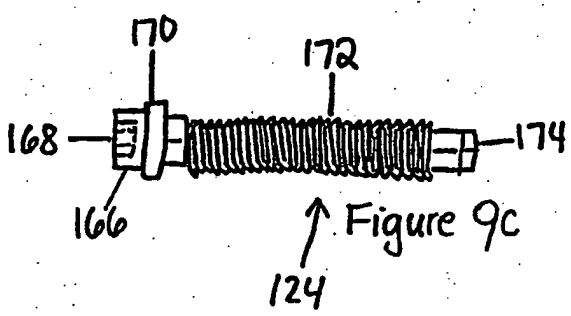

Figure 9C

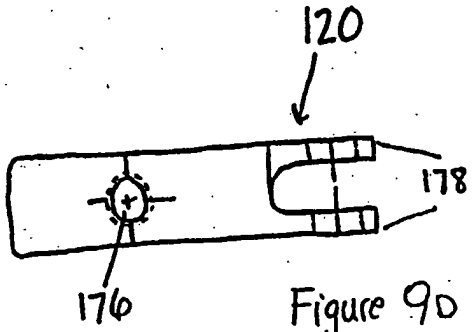

Figure 9D

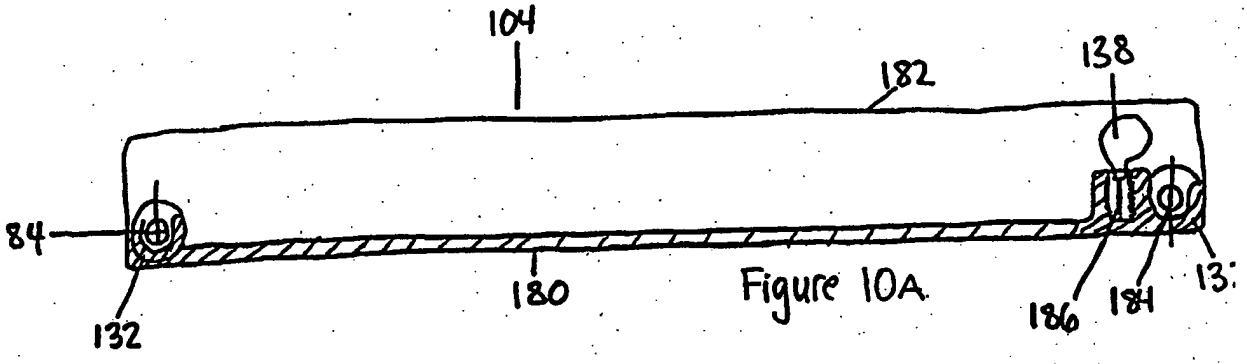

Figure 10A

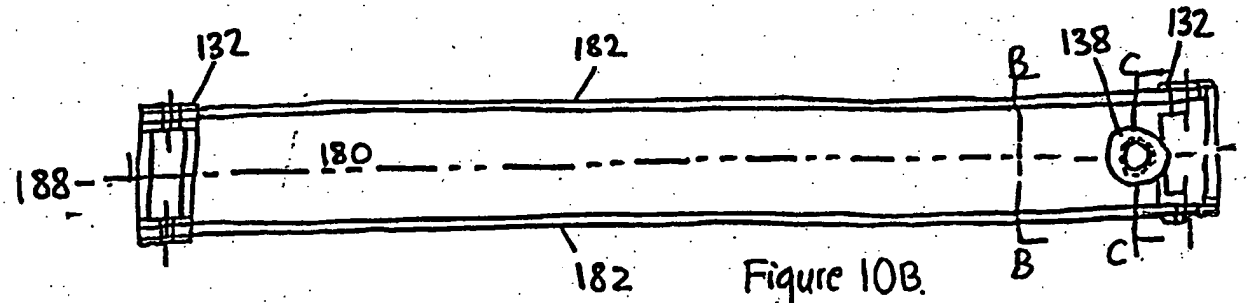

Figure 10B

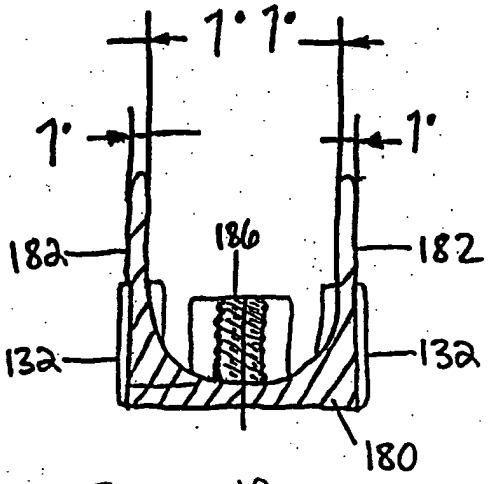

Figure 10c.
B-B

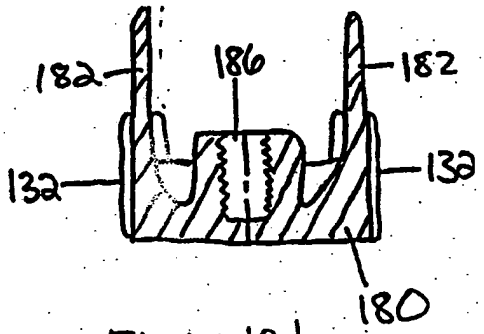

Figure 10d
C-C

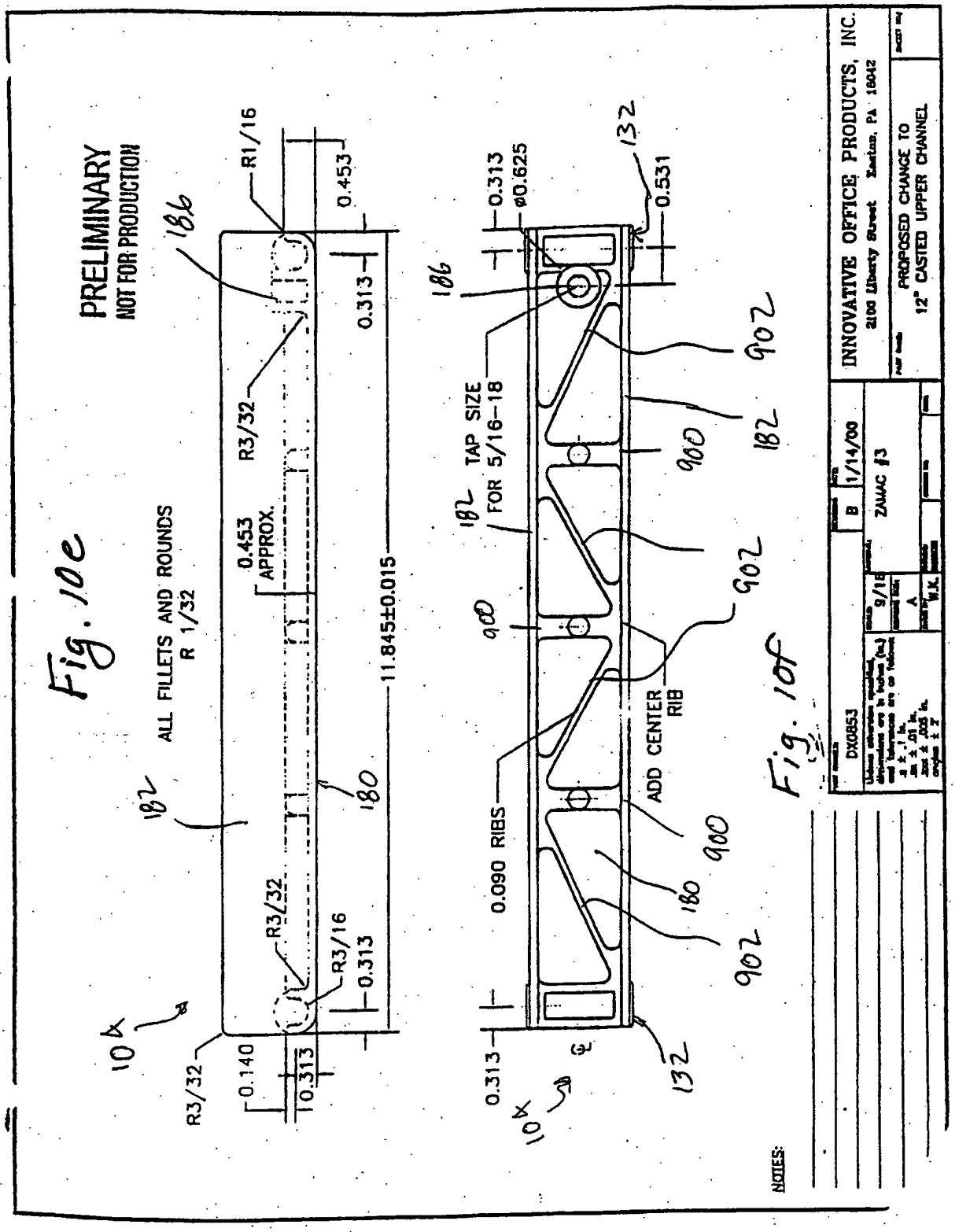

Fig. 10e

Fig. 10f

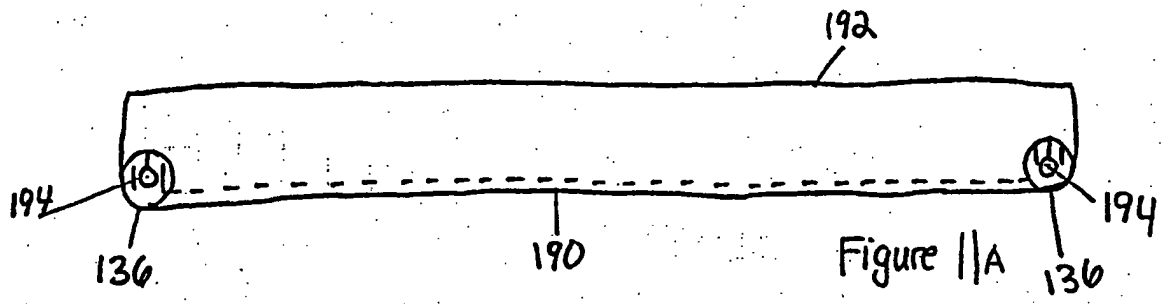

Figure 11A

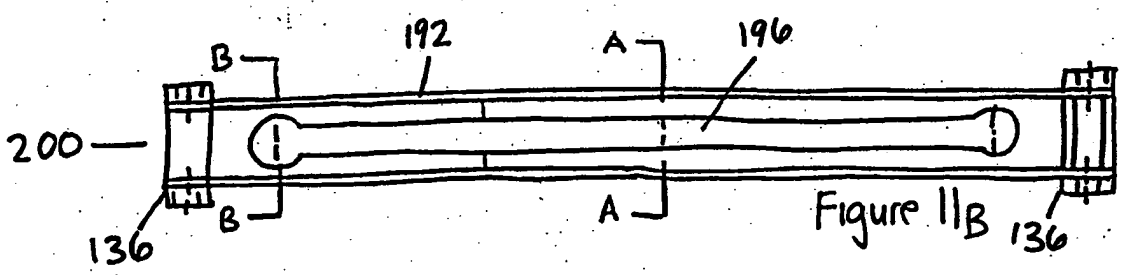

Figure 11B

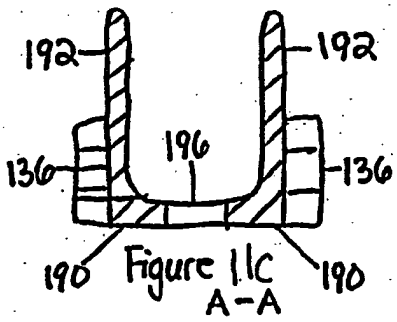

Figure 11C
A-A

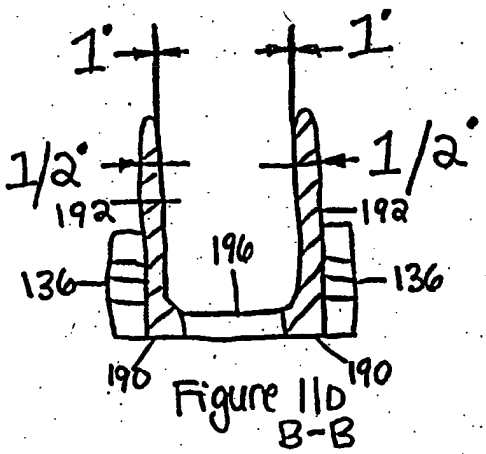

Figure 11D
B-B

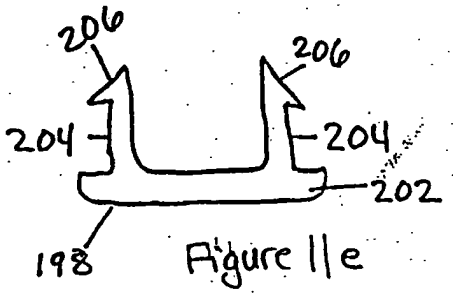

Figure 11e

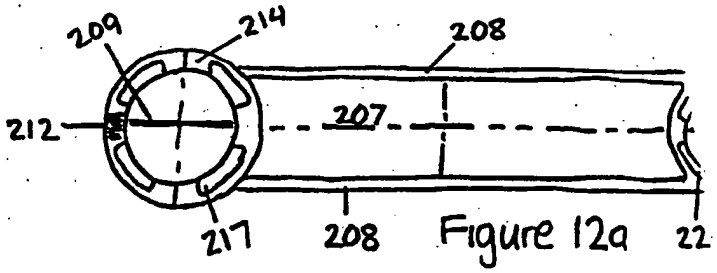

Figure 12a

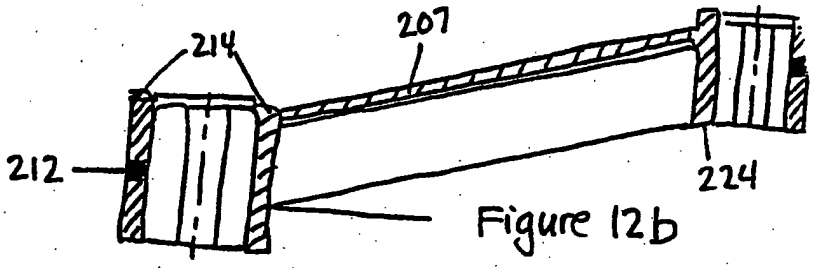

Figure 12b

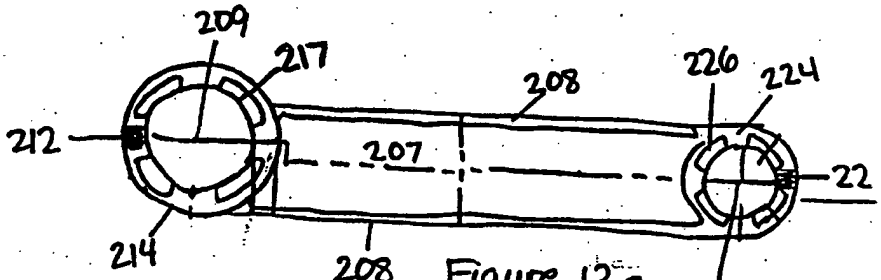

Figure 13a

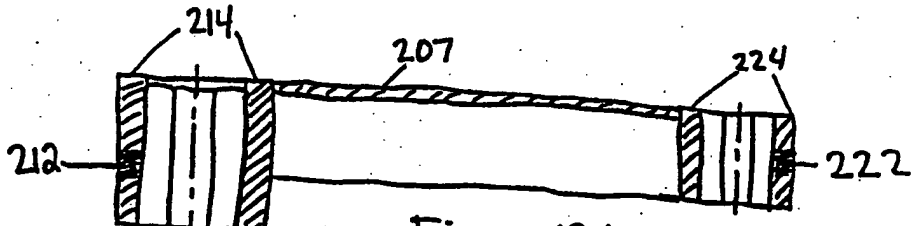

Figure 13b

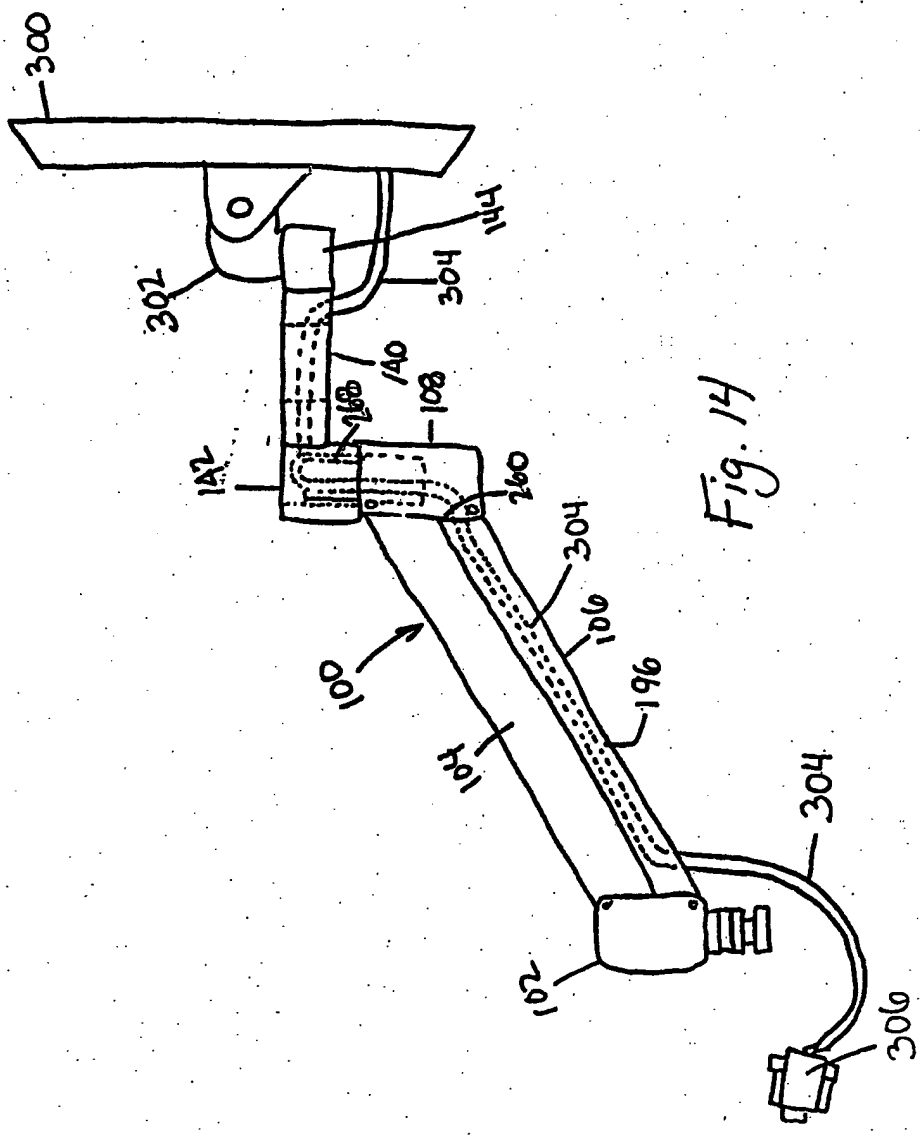

Fig. 14

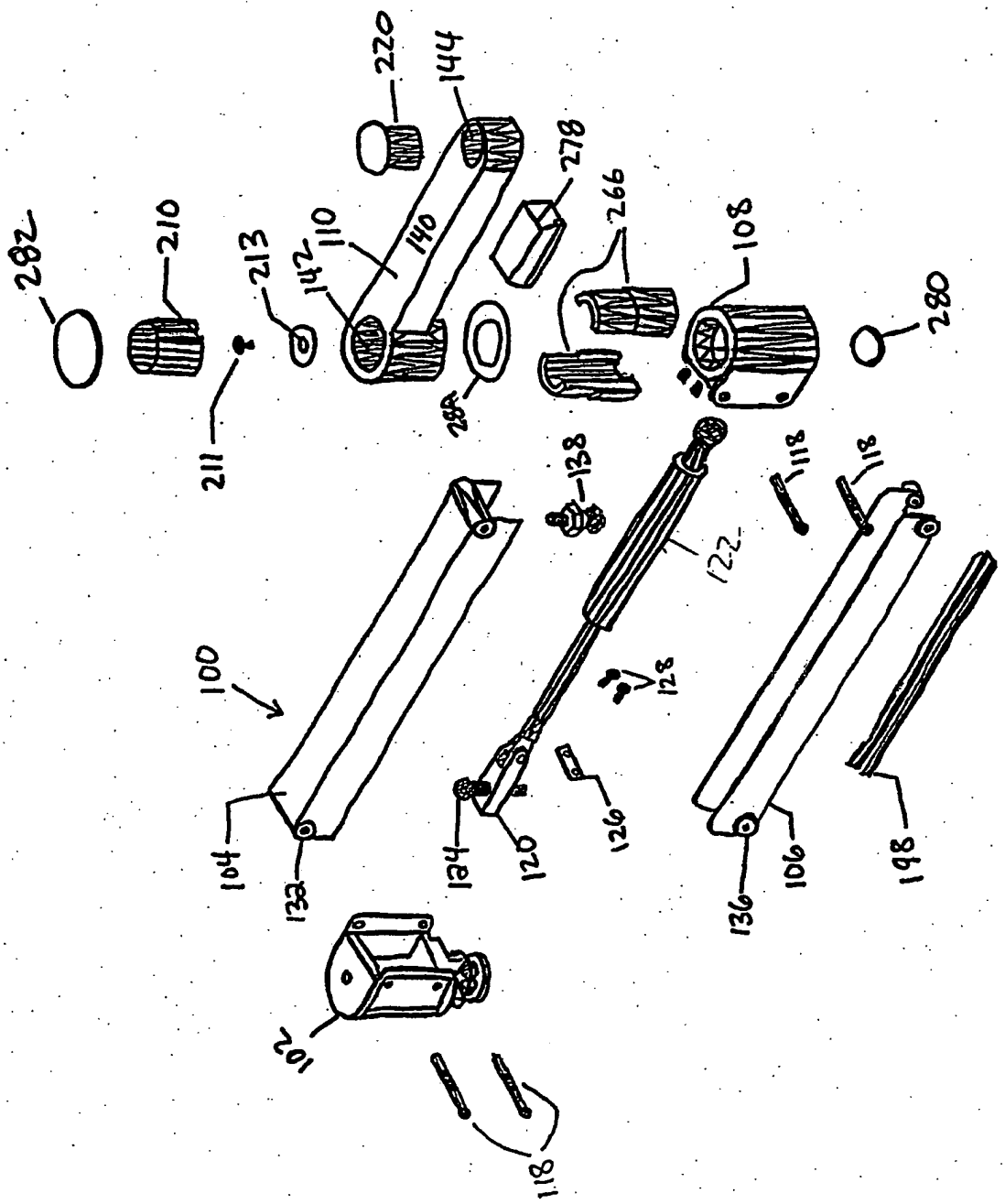
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Fig. 15

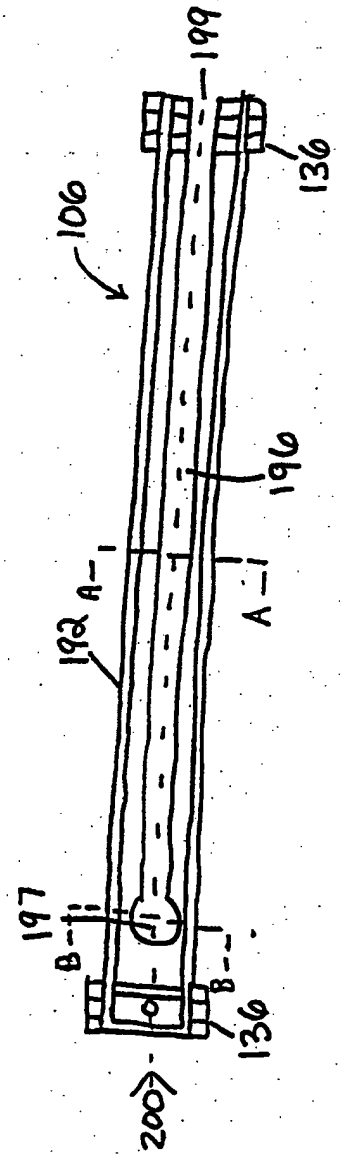
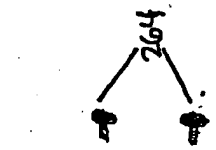


Fig. 16



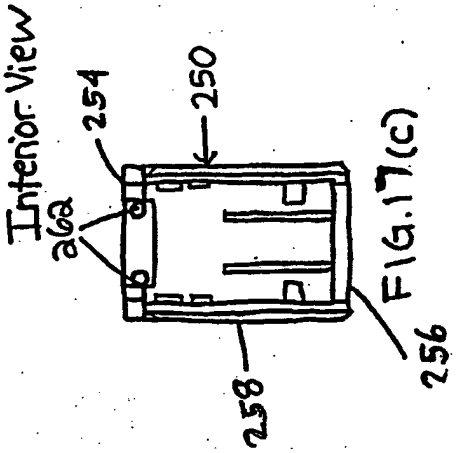


FIG. 17(c)

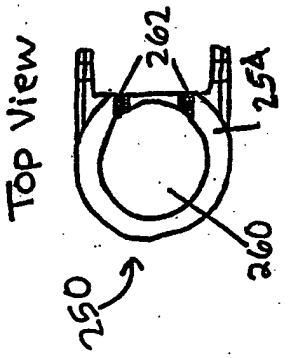


FIG. 17(a)

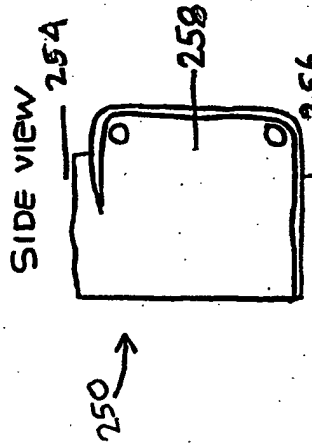


FIG. 17(b)

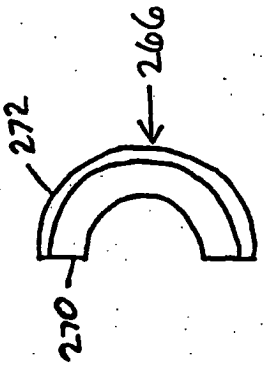


Figure 18(c)

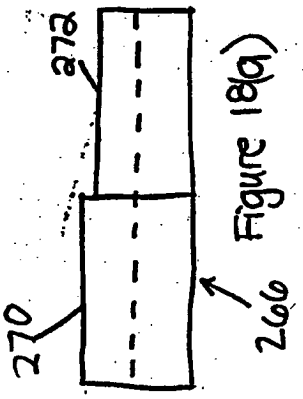


Figure 18(a)

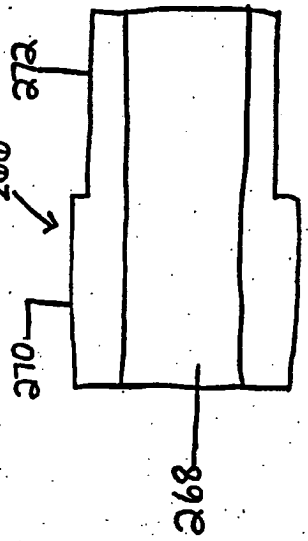


Figure 18(b)

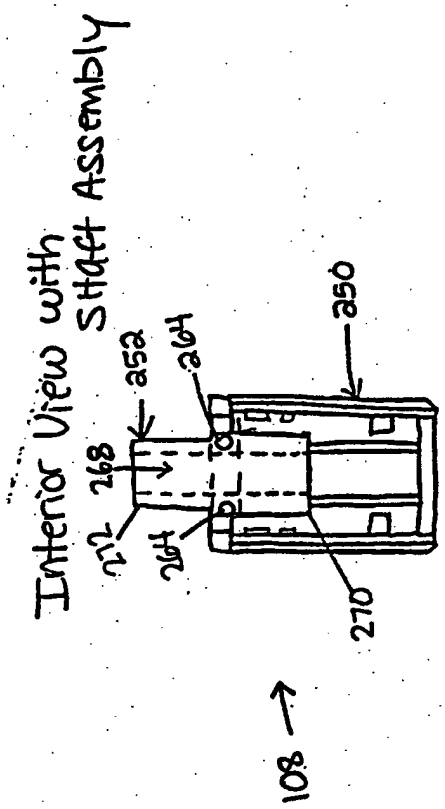
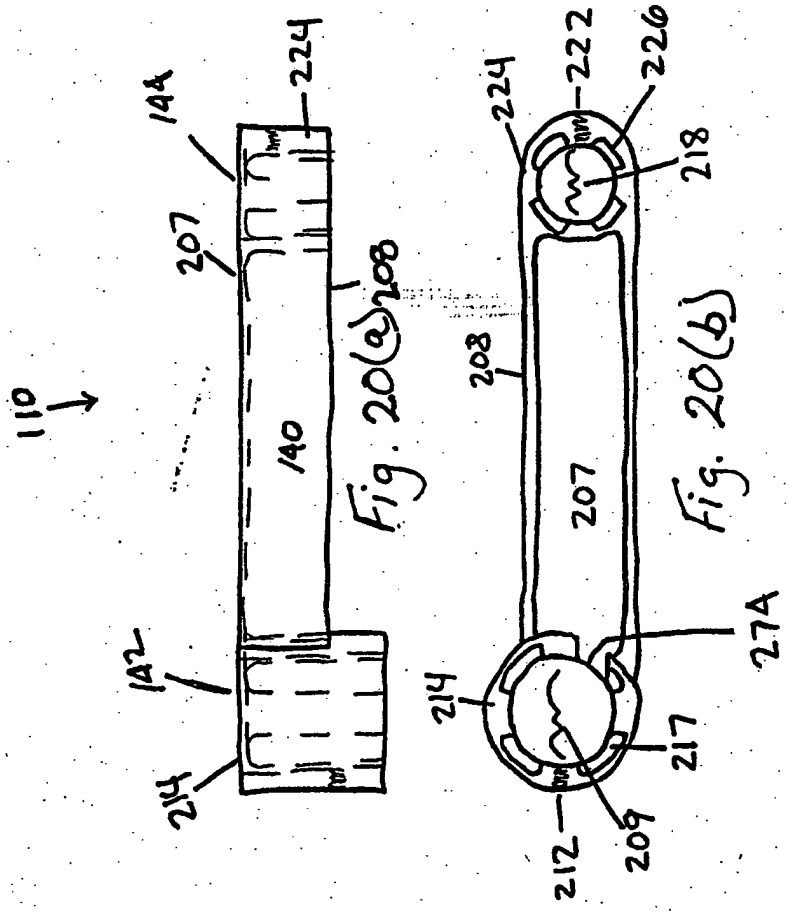
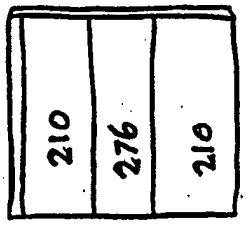

Interior View with Shaft Assembly
250
264
252
268
254
270
108

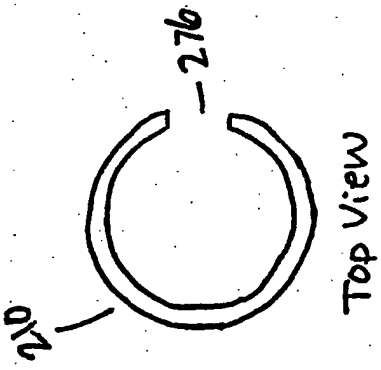
Fig. 19





Side view

Fig. 21(b)



Top View

Fig. 21(a)

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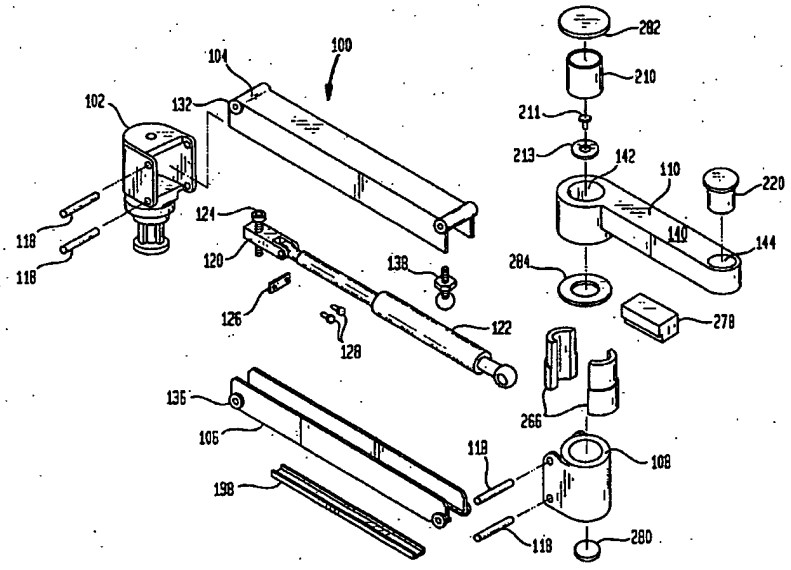
(54) Title: ARM APPARATUS FOR MOUNTING ELECTRONIC DEVICES



(57) Abstract: An extension arm (100) suitable for mounting a flat-screen electronic peripheral device, such as a computer monitor or television, comprises a forearm extension (110) that has at one end a first coupling for attachment to a tilter, a platform or other means for supporting a flat-screen device and at the other end a second coupling with a slot formed therein. The extension arm (100) also comprises a pair of endcaps (102, 108) each having a shaft. The shaft of the first endcap (102) is pivotably rotatable in a support mount, such as a wall, desk or pole mount. The shaft of the second endcap (108) is hollow and is pivotably rotatable in the second coupling of the forearm extension (110). The extension arm (100) also comprises an upper channel (104) and a lower channel (106). Each channel has at opposite ends integrally cast rollers which are pivotably attached to each of the endcaps (102, 108). The lower channel (106) has a cable channel formed therein. The upper and lower channels (104, 106) and the endcaps (102, 108) form an adjustable parallelogram. The shape of the parallelogram is retained by a gas spring (122), which is attached at a first end to a ball stud mounted in the upper channel (104) and adjustably mounted at a second end to the first endcap (102). A clevis (120) is located within the first endcap (102) and is pivotably attached to the second end of the gas spring (122). A threaded rod (124) threadedly engages the clevis (120), such that the clevis (120) slides within the first endcap (102) when the threaded rod (124) rotates around its axial centerline. A cable from the flat-screen device can be hidden from view by being disposed within the forearm extension (110), the second endcap (108), and the lower channel (106) of the extension arm (100).

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ARM APPARATUS FOR MOUNTING ELECTRONIC DEVICES

Field Of The Invention

This invention relates to an arm apparatus for mounting electronic devices, and more specifically to an extension arm suitable to mount a flat-screen electronic peripheral device, such as a computer monitor or a television.

Background Of The Invention

Adjustable extension arms for mounting electronic peripheral devices, such as a computer monitor or a television, are well known in the prior art. Figs. 1-7 illustrate an extension arm 10 for mounting a peripheral device, in accordance with the prior art. As shown in Fig. 1, the main elements of the extension arm 10 are a first endcap 12, an upper channel 14, a lower channel 16, a second endcap 18, and a forearm extension 20.

The first endcap 12 has an endcap shaft 22 that is pivotably attachable to a rigid support mount (not shown), such as an orifice sized to accept the endcap shaft 22 or a track configured and sized to engage the grooves on endcap shaft 22. The first endcap 12 is pivotably coupled via pins 24 to both the upper channel 14 and the lower channel 16. The opposite ends of the upper channel 14 and the lower channel 16 are pivotably coupled via pins 24 to the second endcap 18. The second endcap 18 is coupled to the forearm extension 20 via a forearm extension pin 92. The forearm extension 20 has a vertically disposed hole 26 therethrough for accepting a device mount (not

shown) such as a tilter, platform or other apparatus.

The combination of the upper and the lower channels 14, 16 and the first and the second endcaps 12, 18 form an adjustable parallelogram that permits a device coupled to the forearm extension 20 to be raised and lowered to a desirable height. The parallelogram retains its position by employing a gas spring 28, which is pivotably and adjustably attached to the first endcap 12 and the upper channel 14, as will be further described below. Generally, the gas spring 28 is sized so as to have a fixed length until an upward or downward force is exerted at the second endcap 18 that exceeds the gas spring's designed resistance. Thus, the gas spring 28 causes the parallelogram to retain its position when the only force exerted at the second endcap 18 is the weight of the device, but permits the parallelogram to be adjusted when a user pushes the device coupled to the forearm extension 20 up or down.

Fig. 2 illustrates a side view of the first endcap 12, having the endcap shaft 22 disposed on a first end 30 of the first endcap 12. To provide a rigid connection between the two pieces, the endcap shaft 22 is typically machined from steel and is inserted into the first end 30 during the casting process of the first endcap 12. The endcap shaft 22 has a hole 32 formed in an end of the endcap shaft 22 that is inserted into the first endcap 12. The first endcap 12 is typically fabricated from cast aluminum. The first endcap 12 also has a second end 34 having a hole 36 disposed therethrough. Disposed within the first endcap 12 is a threaded rod 38. A first end 40 of the threaded rod 38 is inserted into the hole 32 at the base of the

endcap shaft 22. A second end 42 of the threaded rod 38 is aligned with the hole 36 and is held in place by a clip 44. The clip 44 is fastened to an inner surface of the first endcap 12 by screws 46.

Fig. 3 illustrates a sideview of a clevis 48 which is threadedly mounted on the threaded rod 38. The clevis 48 includes a tapped hole 50 in the center thereof for receiving the threaded rod 38, as shown in Fig. 2. At a first end of the clevis 48 is a pair of fastening members 52, 54 to which are fastened one end of the gas spring 28. A second end 56 of the clevis 48 is configured to slidably engage a track 58 which is integrally molded in the first endcap 12 (see Fig. 2). The second end 42 of the threaded rod 38 is configured to be engaged by a hex-shaped key which is inserted through the hole 36 when the second end 42 is properly aligned with the hole 36. The hex-shaped key is employed so as to rotate the threaded rod 38 along its axis of rotation. When the threaded rod 38 is rotated along its axis of rotation, the clevis 48 moves along the length of the threaded rod 38 in a direction that corresponds to the direction which the hex-shaped key is turned. This movement of the clevis 48 permits the gas spring 28 to be adjusted.

Figs. 4(a) and 4(b) illustrate the upper channel 14, which comprises channel bottom 60 from which extend two channel sidewalls 62. The channel bottom 60 and the sidewalls 62 are typically stamped from 13 gauge steel sheet in order to give the upper channel 14 a desired degree of structural rigidity. At each of the ends of the channel bottom 60, a semi-circular region 64 of the sidewalls 62 is cut out to accommodate cold-

rolled steel rollers 66, which have a hole 68 therethrough for receiving the pins 24. The rollers 66 are rigidly attached to the upper channel 14 by MIG welding along the edge of the semi-circular cut out region 64 and along the ends of the channel bottom 60.

Additionally, the upper channel 14 comprises stiffener 70, which is welded to an inner surface of the channel bottom 60. Besides providing additional structural rigidity to the upper channel 14, the stiffener 70 has a hole disposed at one end with a threaded ball stud 72 placed within the hole and fixed in place by a nut 74. The ball stud 72 is configured and sized to receive one end of the gas spring 28. The longitudinal centerline 76 of the upper channel 14 is illustrated in Fig. 4(b).

Figs. 5(a) and 5(b) illustrate the lower channel 16 which comprises a channel bottom 78 from which extend two channel sidewalls 80. As with the upper channel 14, the channel bottom 78 and the sidewalls 80 are typically stamped from 3 gauge steel sheet, which is relatively heavy in order to give the lower channel 16 a desired degree of structural rigidity. At opposite ends of the channel bottom 78, a semi-circular region 82 of the sidewalls 80 is cut out to accommodate cold-rolled steel rollers 84, which have a hole 86 therethrough for receiving the pins 24. The rollers 84 are rigidly attached to the lower channel 16 by MIG welding along the edge of the semi-circular cut out region 82 and along the ends of the channel bottom 78. The longitudinal centerline 88 of the lower channel 16 is illustrated on Fig. 5(b).

Fig. 6 illustrates the second endcap 18. Unlike the first endcap 12, the second endcap 18 does not have an endcap shaft, nor does it have a clevis assembly for attachment to the gas spring 28. Instead, the second endcap 18 has a hole 90 disposed in a bottom end for receiving the forearm extension pin 92, and a hole 94 in a side for inserting a pin 96 into the forearm extension pin 92, as illustrated in Fig. 1.

Fig. 7 illustrates the forearm extension 20 having the forearm extension pin 92 welded thereto. The forearm extension pin 92 has a hole 98 formed in an upper end to receive the pin 96. The forearm extension 20 is configured to be pivoted around the forearm extension pin 92, and is held in place within the second endcap 18 by the pin 96 which penetrates the hole 94 of the second endcap 18 and the hole 98 of the forearm extension pin 92.

Due to recent advances in flat-screen technology, there is a demand for adjustable extension arms that are particularly suited for use with flat-screen devices, such as flat-screen computer monitors and televisions. Extension arms 10 of the prior art, such as the one shown in Figs. 1-7 and others like it, are ill-suited for flat-screen monitors and televisions, in that they are bulky and cumbersome. Moreover, due to the configuration of its various parts, extension arms 10 of the prior art cannot be flattened against a mounting surface so that the entire extension arm 10 is hidden behind the flat-screen device when the device is substantially flush with the mounting surface. Furthermore, the extension arms 10 of the prior art are not designed so as to enable the cables to and from a device

to be substantially hidden, and thus protected, within the extension arm 10 itself. Additionally, the extension arms 10 of the prior art are costly to manufacture and difficult to assemble.

Thus, there is a need for an extension arm suitable to mount a flat-screen electronic peripheral device, such as a computer monitor or television, that is inexpensive and easy to manufacture and assemble, and that permits a flat-screen device to be mounted substantially flush with the mounting surface. Moreover, there is a need for an extension arm that enables the cables to and from the flat-screen device to be substantially hidden from view within the extension arm and thus protected from the elements.

Summary Of The Invention

The present invention, in accordance with one embodiment, relates to an extension arm suitable for mounting a flat-screen electronic peripheral device, such as a computer monitor or television. The extension arm is inexpensive and easy to manufacture and assemble, and permits a flat-screen device to be mounted substantially flush with a mounting surface. The extension arm includes a first and a second endcap, an upper and a lower channel, and a forearm extension.

Each endcap includes a body and a shaft. The shaft of the first endcap is pivotably rotatable in a support mount, such as a wall, a desk or a pole mount. The shaft of the second endcap is rotatably coupled to the forearm extension. The upper channel and the lower channel each have rollers integrally cast

at both ends. The rollers are pivotably attached to the respective endcap. The upper and lower channels and the endcaps form an adjustable parallelogram. The shape of the parallelogram is retained by a gas spring. A first end of the gas spring is attached to a ball stud mounted in the upper channel. A second end of the gas spring is adjustably mounted to the first endcap.

The forearm extension is a U-shaped channel with a first coupling disposed at one end for rotatably coupling to a device mount, such as a tilter, a platform or other means for supporting a flat-screen device. The forearm extension has a second coupling disposed at the other end for rotatably coupling to the shaft of the second endcap.

The first endcap also includes a clevis pivotably attached to the second end of the gas spring and a threaded rod threadedly engaging the clevis, such that the clevis slides within the first endcap when the rod rotates around its axial centerline. The threaded rod is rotatably secured within the first endcap by a retainer clip and a pair of screws.

Another embodiment permits cables to be substantially hidden from view by being disposed within the extension arm. The cable is disposed within the lower channel, the second endcap and the forearm extension. The lower channel includes a cable channel formed in a lower surface thereof so that the cable can be inserted within the lower channel. The cable is held in place within the lower channel by a cable cover which engages the cable channel. The second endcap has a hollow shaft so that the cable can be fed through the shaft to the forearm

extension. The second coupling of the forearm extension has a hole in an interior wall so that the cable can be disposed through the hole and into the U-shaped channel. The cable is held within the U-shaped channel by a cable clip.

Brief Description Of The Drawings

The accompanying drawings, which are incorporated in and form a part of the specification, illustrate the embodiments of the present invention and, together with the description, serve to explain the principles of the invention.

Fig. 1 is an assembly drawing of an extension arm for mounting a computer monitor, in accordance with the prior art;

Fig. 2 illustrates a first endcap of an extension arm, in accordance with the prior art;

Fig. 3 illustrates the clevis assembly of an extension arm, in accordance with the prior art;

Figs. 4a and 4b illustrate the upper channel of an extension arm, in accordance with the prior art;

Figs. 5a and 5b illustrate the lower channel of an extension arm, in accordance with the prior art;

Fig. 6 illustrates a second endcap of an extension arm, in accordance with the prior art;

Fig. 7 illustrates a forearm extension of an extension arm, in accordance with the prior art;

Fig. 8 is an exploded assembly drawing of an extension arm, according to one embodiment of the invention;

Figs. 9(a)-(d) illustrate several views of the endcaps of Fig. 8, according to one embodiment of the invention;

Figs. 10 (a)-(f) illustrate several views of the upper channel of Fig. 8, according to one embodiment of the invention;

Figs. 11(a)-(e) illustrate several views of the lower channel of Fig. 8, according to one embodiment of the invention;

Figs. 12(a) and 12(b) illustrate the forearm extension of Fig. 8, according to one embodiment of the invention;

Figs. 13(a) and 13(b) illustrate the forearm extension of Fig. 8, according to one embodiment of the invention;

Fig. 14 is a side view of an extension, according to one embodiment of the invention;

Fig. 15 is an exploded assembly drawing of the extension arm of Fig. 14, according to one embodiment of the invention;

Figs. 16 illustrates the lower channel of Fig. 14, according to one embodiment of the invention;

Figs. 17a-c illustrate several views of the partially enclosed housing of the second endcap of Fig. 14, according to one embodiment of the invention;

Figs. 18a-b illustrates several views of a shaft assembly of the second endcap of Fig. 14, according to one embodiment of the invention;

Fig. 19 illustrates an assembled second endcap according to one embodiment of the invention;

Figs. 20a-b illustrate the forearm extension of Fig. 14, according to one embodiment of the invention; and

Figs. 21a-b, illustrate several views of a bushing used in the second female coupling of the extension arm of Figs. 20a-b, according to one embodiment.

Detailed Description

Of The Preferred Embodiments

In describing the preferred embodiments of the invention illustrated in the drawings, specific terminology will be used for the sake of clarity. However, the invention is not intended to be limited to the specific terms so selected, and it is to be understood that each specific term includes all technical equivalents that operate in a similar manner to accomplish a similar purpose.

With reference to the drawings, in general, and Figs. 8 through 22 in particular, the apparatus of the present invention is disclosed. Embodiments of an extension arm are suitable for mounting a flat-screen electronic peripheral device, such as a computer monitor or television, that is inexpensive and easy to manufacture and assemble, and permits a flat-screen device to be mounted substantially flush with a mounting surface. Additional embodiments can substantially hide from view the cables to and from the flat-screen electronic peripheral device within the extension arm.

Fig. 8 is an exploded assembly drawing of an extension arm 100 in accordance with one embodiment. The extension arm 100 comprises a first endcap 102, an upper channel 104, a lower channel 106, a second endcap 108, and a forearm extension 110.

Figs. 9a and 9b illustrate the first endcap 102 and the second endcap 108, in accordance with one embodiment of the invention. In the embodiment shown, the first and the second endcaps 102, 108 include a partially-enclosed housing 112 which has flat, oppositely-disposed endwalls 146 and 148 fixedly

connected by a sidewall 150. The sidewall 150 extends partially around the partially-enclosed housing 112 so as to permit manipulation of components to be assembled within the first endcap 102. In one embodiment, the endwalls 146 and 148 are semi-circular in shape and are connected along a semi-circular edge to the sidewall 150, which extends perpendicularly therebetween.

Fig. 10a illustrates the first and the second endcaps 102, 108 having a shaft 114 disposed on the endwall 148. The shaft 114 is preferably integrally molded to the endwall 148 of the first and the second endcaps 102, 108. Preferably, the entire first and second endcaps 102, 108 (the partially enclosed housing 112 and the shaft 114) is molded, by for example cast molding, from a material, such as zinc. The shaft 114 is integrally molded with the endcaps 102, 108 by employing interlocking mold technology. Interlocking molds permit a near-perfect mold to be made, minimizing the machining that is required to insure that the shaft 114 is not out-of-round. By minimizing the amount of machining that is required to be performed on the shaft 114, the use of interlocking molds insures that the strength of the casting, which is primarily located in the skin of the cast, is maximized.

Thus, the cost of manufacturing each of the endcaps 102, 108 is reduced significantly. That is, the cost of the steel shaft 22 and the manufacturing required to separately machine and then insert the steel shaft 22 into the aluminum cast mold of the prior art is reduced. Moreover, the preferred embodiment of using zinc cast mold endcaps 102, 108 (though the present

invention is not limited to this embodiment) is an improvement over the aluminum endcaps 12, 18 employed in the prior art as zinc is stronger and more flexible than the aluminum.

The endwall 146 has a hole 152 disposed therethrough. Within the partially enclosed housing 112 and integrally molded on the sidewall 150 are stops 156 disposed in proximity to the endwalls 146, 148; trough walls 158 disposed longitudinally along the inner surface of the sidewall 150 between the endwalls 146 and 148 so as to define a trough 160 therebetween; and shelves 162 disposed adjacent to the endwall 148.

The stops 156 serve to stop upward or downward movement of the extension arm 100 when ends of the upper channel 104 and the lower channel 106, respectively, meet the stops 156 when the extension arm 100 is in extended positions. The trough 160 disposed between the trough walls 158 allows a clevis 120 to be moved therein, as discussed in more detail later. Fig. 10b illustrates the shelves 162 defining co-planar faces separated by a groove 164. The shelves 162 have a connection means, such as self-tapping screw holes 154 disposed therein. The co-planar faces of the shelves 162 are configured to engage a retainer clip 126, which is fastened in place by, for example, a pair of screws 128. When the retainer clip 126 is fastened in place, the groove 164 defines a spacing for accepting one end of a threaded rod 124, as discussed in more detail below.

The first endcap 102 and the second endcap 108 are identical at this point. That is, unlike the prior art endcaps 12, 18 which are different from each other, the endcaps 102, 108 are advantageously manufactured the same way. Thus, the cost of

manufacturing two different kinds of endcaps are eliminated.

The threaded rod 124 and the clevis 120 are now fabricated and assembled in only the first endcap 102. The threaded rod 124 is employed within the first endcap 102 so as to adjustably support the clevis 120. Fig. 9c illustrates the threaded rod 124 having a first end 166 which has a circular cross-section within which is axially disposed a shaped opening 168, for example a hex-shaped opening, for accepting a shaped key (not shown), such as a hex-shaped key. Advantageously, a cross-sectional diameter of the first end 166 is smaller than a cross-sectional diameter of the hole 152, so as to be inserted therein. Adjacent the first end 166 is a shoulder 170. Advantageously, the shoulder 170 has a circular cross-section having a diameter that is larger than the cross-sectional diameter of the hole 152. Thus, in a preferred embodiment, the shoulder 170 abuts an inner surface of the endwall 146 and retains the first end 166 within the hole 152.

The threaded rod 124 also includes a threaded section 172 which is configured to threadedly engage the clevis 120. A second end 174 of threaded rod 124 is disposed in the groove 164 located between the shelves 162 of the first endcap 102. Preferably, the second end 174 of the threaded rod 124 has a circular cross-section having a diameter that is smaller than the size of the groove 164, such that the second end 174 is supported between the shelves 162 but is free to rotate therein.

As previously mentioned, threadedly mounted on the rod 124 is the clevis 120. The clevis 120 as illustrated in Fig. 9d, has a tapped hole 176 formed therein for receiving the threaded

rod 124. The clevis 120 also has a pair of fastening members 178 at a first end to which are fastened a first end of a gas spring 122. The second end of the clevis 120 is configured to slidably engage the trough 160.

When the first end 166 of the threaded rod 124 is engaged by a shaped key, the shaped key is employed so as to rotate the threaded rod 124 around its axial centerline. When the threaded rod 124 is rotated around this axis of rotation, the clevis 120 moves along the length of the threaded rod 124 in a direction that corresponds to the direction which the shaped key is turned. This movement of the clevis 120 permits the gas spring 122 to be adjusted.

The partially enclosed housing 112 of the first and the second endcaps 102, 108 is configured with, for example, holes 116 to receive a connection mechanism, such as pins 118, therethrough. The shaft 114 of the first endcap 102 is configured to be inserted for pivotable rotation in a support mount (not shown), which may be a wall mount, a desk mount, a pole mount, or a configurable mount. The shaft 114 of the second endcap 108 is configured to be inserted for pivotable rotation in the forearm extension 110 which will be described in more detail later.

The first endcap 102 of the current invention is advantageous to the first endcap 12 of the prior art, and others like it because, for instance, the assembly time required to rotatably fasten the threaded rod 124 in the first endcap 102 is greatly reduced. In order to assemble the threaded rod 124 of the present invention, the first end 166 is inserted into the

hole 152 until the shoulder 168 abuts the inner surface of the endwall 146. The second end 174 of the threaded rod 124 is then positioned in the groove 164 between the shelves 162. The second end 174 is held in place by the retainer clip 126 which is fastened in place by, for example, the screws 128, which are easily accessible due to their proximity above the threaded rod 124. The first end 166 of the threaded rod 124 is perfectly aligned with the hole 152, and will remain so, because it is inserted for rotation therein.

By contrast, the assembly of the threaded rod 38 in the first endcap 12 of the prior art is more complicated, and therefore, more costly. For example, the first end 40 is inserted into the hole 32 in the base of the endcap shaft 22. Next, the clevis 48 is mounted on the threaded rod 38, and then the second end 42 is fastened inside the first endcap 12 by the clip 44. The clip 44 is also employed to align the second end 42 relative to the hole 36. Thus, the clip 44 must be fastened inside the first endcap 12 with precision, so as to insure that the second end 42 is aligned relative to the hole 36 such that the second end 42 can be engaged by a hex-shaped key which is inserted into the hole 36. Moreover, the screws 46 which are employed to the fasten clip 44 inside the first endcap 12 are difficult to access due to their position underneath the threaded rod 38, thus complicating the process of aligning the second end 42 with the hole 36. In addition, the fastening of the clip 44 inside the first endcap 12 is also rendered more difficult because the clevis 48 is already attached to the gas spring 28.

Moreover, unlike the prior art, the current invention does not require a forearm extension pin 92 to connect the second endcap 18 to the forearm extension 20. Moreover, the pin 96 is not required to hold the forearm extension pin 92 within the second endcap 18. Instead, the current invention uses the shaft 114 of the second endcap 108 to connect the second endcap 108 to the forearm extension 110. Thus, manufacturing costs can be reduced since there in no need to manufacture the forearm extension pin 92 or the pin 96, and there is no reason to form the hole 94 within the second endcap 18 or the hole 98 within the forearm extension pin 92 to accept the pin 96.

Figs. 10a-f illustrate several views of the upper channel 104, according to one embodiment of the invention. The upper channel 104 includes a U-shaped body 130 and integrally cast rollers 132 disposed at opposite ends of the U-shaped body 130. The U-shaped body 130 comprises a channel bottom 180 from which extend two channel sidewalls 182. The channel bottom 180, the sidewalls 182 and the rollers 132 of the upper channel 104 are preferably integrally cast from a material, such as zinc, which gives the upper channel 104 a lesser weight, and a degree of structural rigidity, more suitable for lighter-weight flat-screen devices than the prior art upper channel 14 which is stamped from heavy gauge steel. The rollers 132 have a hole 184 therethrough (either cast or subsequently drilled) for receiving a connection mechanism, such as the pins 118. Additionally, the upper channel 104 comprises a threaded hole 186 configured and sized to receive a threaded end of a ball stud 138. The threaded hole 186 is also integrally cast. The ball stud 138 is

configured and sized to receive a second end of the gas spring 122.

Unlike the prior art upper channel 14 in which the U-shaped channel is formed by heating a piece of steel and bending the steel to form the channel bottom 60 and the sidewalls 62, the upper channel 104 of the invention is cast molded. The use of cast molding ensures the angle between the channel bottom 180 and the sidewalls 182 is exactly the same each and every time. Moreover, cast molding enables the sidewalls 182 to be tapered. As illustrated in Figs. 10c and 10d, both an outer surface and an inner surface of the sidewalls 182 may taper in, for example, by approximately 1 degree. It should be noted that the taper is not limited to 1 degree, and that the taper of the inner surface and the outer surface need not be the same.

The taper provides several advantages including more clearance between the upper and the lower channels 104, 106 when the upper and the lower channels 104, 106 are brought together during usage. That is, the inner surface of the sidewalls 182 being displaced by 1 degree means that there will be additional clearance for the lower channel 106 to fit therewithin. The additional clearance will help prevent the upper channel 104 and the lower channel 106 from scraping together. Thus, damage to the paint or other coating that may cover the upper and the lower channels 104, 106 will be further reduced, if not eliminated. Moreover, less material is needed at outer edges of the sidewalls 182. Furthermore, the taper is more aesthetically pleasing to the eye of the user.

In a preferred embodiment, as illustrated in Figs. 10e and

10f, the channel bottom 180 includes cross bracing to increase the strength and rigidity of the upper channel 104. The cross bracing may include center ribs 900 and cross ribs 902. The cross bracing increases the rigidity of the upper channel 104 by approximately 1.6 times that of upper channel 104 without the cross bracing.

The upper channel 104 has numerous manufacturing advantages over the upper channel 14 of the prior art, and others like it. For instance, with reference to the upper channel 14 of the prior art shown in Figs. 4a-b, the welding which is required to attach the rollers 66 to the upper channel 14 is difficult to perform. The axial centerlines of the rollers 66 must be near-perfectly parallel to each other, while being near-perfectly perpendicular to the longitudinal centerline 76 of the channel bottom 60. The tolerances for these angles are very small so as to insure that the lower channel 16 engages the upper channel 14 when the parallelogram is adjusted. These tolerances are very difficult to meet when the rollers 66 are welded to the upper channel 14. By contrast, the rollers 132 of the upper channel 104 of the present invention are integrally cast so as to insure that the axial centerlines of rollers 132 are simultaneously perfectly parallel to each other and perfectly perpendicular to a longitudinal centerline 188 of the channel bottom 180.

Additionally, with further reference to Figs. 4a-b and as previously noted, due to the hardness of the steel employed for the prior art upper channel 14, the rollers 66 must be MIG welded thereto, which in turn requires the rollers 66 to be fabricated from expensive cold-rolled steel. Although it is

tempting for a manufacturer of the rollers 66 to employ a cheaper material, such as leadloy, these cheaper materials do not provide a safe and consistent weld when joined to the steel upper channel 14. Typically, tests must be performed on the roller material to insure that leadloy has not been supplied. By contrast, the upper channel 104 of the present invention requires no welding, eliminating the cost of aligning the rollers, the cost of performing the welding and the cost of testing the rollers to determine if they are a suitable welding material.

An additional disadvantage of welding the rollers 66 to the upper channel 14 is that the heat produced by welding the rollers 66 to the upper channel 14 may cause the upper channel 14 to curl or deform. If this occurs, alignment of the rollers 66 is ruined and the upper channel 14 is rendered useless, requiring it to be discarded. By eliminating any welding required during the manufacture of the upper channel 104, the likelihood of heat-deforming the upper channel 104 is also eliminated and materials are not wasted.

As previously mentioned, the prior art upper channel 14 is made of steel, which means that the upper channel 14 is formed by heating a piece of steel and bending the steel to form the channel bottom 60 and the sidewalls 62. Thus, precise manufacturing is required to ensure the sidewalls 62 extend up from the channel bottom 60 at 90 degree angles. If the angle is slightly off it will likely cause the upper channel 14 and the lower channel 16 to scrape against one another. The use of cast molding in the current invention ensures the angle between the

channel bottom 180 and the sidewalls 182 is exactly the same each and every time. Thus, the likelihood of scraping is greatly reduced, if not eliminated.

Additionally, the upper channel 104 eliminates the requirement for the stiffener 70, which, with reference to Figs. 4a-b, is welded to the inner surface of the channel bottom 60 in the upper channel 14 of the prior art. Unlike the upper channel 14 of the prior art, the upper channel 104 does not require the additional structural rigidity provided by the stiffener 70. By eliminating the stiffener 70, the upper channel 104 of the present invention also saves the steps required to weld the stiffener 70 to the channel bottom 60 which are required by the prior art upper channel 14.

Moreover, additional assembly steps are saved by integrally casting the threaded hole 186 in the upper channel 104 of the current invention. For instance, the prior art upper channel 14 has the threaded ball stud 72 penetrate a hole disposed in the stiffener 70 and is fixed in place by the nut 74. In order to install the ball stud 72, it is required that the threaded end of ball stud 72 be inserted through the hole in the stiffener 70 and be fixed in place by the nut 74 prior to the stiffener 70 being welded in place. No such assembly is required with the upper channel 104 of the present invention.

An additional problem experienced by prior art upper channels 14 is the need to mask openings, such as the holes 68 in the rollers 66 that receive the pins 28 therethrough, when the upper channel is painted or otherwise coated. Specifically, labor is required in order to insert masking material into the

openings and then to remove the masking material after the paint has been applied. By contrast, the openings of the present invention are according to one embodiment, precision-drilled after an application of paint or other coatings, thus eliminating the expense of masking any openings.

Figs. 11a-e illustrate several views of the lower channel 106, according to one embodiment of the invention. The U-shaped body 134 of the lower channel 106 comprises a channel bottom 190 from which extend two channel side walls 192. Unlike the lower channel 16 of the prior art extension arm shown in Figs. 5a-b, which is stamped from heavy gauge steel, the channel bottom 190 and the sidewalls 192 of the lower channel 106 are preferably integrally cast from zinc, which gives the lower channel 106 a lesser weight when compared to heavy gauge steel, and a degree of structural rigidity, more suitable for lighter-weight flat screen devices. At each end of the channel bottom 180 are the rollers 136, which are also integrally cast. The rollers 136 have a hole 194 therethrough (either cast or subsequently drilled) for receiving a connection mechanism, such as the pins 118. The channel bottom 190 may additionally include a cable channel aperture 196 running longitudinally. In the embodiment shown, the cable channel aperture 196 has rounded ends, which improves the rigidity of the lower channel 106. The cable channel aperture 196 is configured to receive a cable cover 198 (illustrated in Fig. 11e). The cable cover 198 is configured to removably fit within the cable channel aperture 196. Thus, cables of the mounted device may be substantially retained within the lower channel 106 so as to hide them from view and

protect them from harm. The cable channel aperture 196 and the cable cover 198 enable cables to be accessed when desired, while securing them within the lower channel 106.

The lower channel 106 has numerous manufacturing advantages over the lower channel 16 of the prior art, and others like it. For instance, as described above with reference to the upper channel 104, the rollers 136 of the lower channel 106 of the present invention are integrally cast so as to insure that the axial centerlines of the rollers 136 are perfectly parallel to each other, and that the axial centerlines of the rollers 136 are perfectly perpendicular to a longitudinal centerline 200 of the channel bottom 190. Thus, the need for precision alignment of the rollers 84 prior to welding to the lower channel 16 is eliminated.

Additionally, and as also described with reference to the upper channel 104, the rollers 136 of the lower channel 106 are integrally cast so no welding is required. Thus, the cost of performing the welding and the cost of testing the rollers to determine if they are a suitable welding material is eliminated. Another advantage of eliminating the need for welding the rollers 136 to the lower channel 106 is reducing the likelihood of heat-deforming the lower channel 106 so that materials are not wasted.

As shown in Figs. 11c and 11d, which are cross-sectional views of the lower channel 106, the sidewalls 192 of the lower channel 106 are tapered. As illustrated, an outer surface of the sidewalls 192 is tapered approximately 1/2 degree while an inner surface is tapered approximately 1 degree. As one skilled

in the art would recognize, the taper is not limited to the illustrated examples. The taper is possible because the lower channel 106 is, in the preferred embodiment, cast molded. As noted above with respect to the upper channel 104, the taper provides more clearance between the upper channel 104 and the lower channel 106 so as to reduce or eliminate the chance of the upper and the lower channels 104, 106 scraping. Moreover, less material is needed at outer edges of the sidewalls 192.

A further advantage, as noted above with respect to the upper channel 104, is that the hole 194 within the rollers 136, according to one embodiment, is precision-drilled after an application of paint or other coatings, thus eliminating the expense of masking any openings.

As illustrated in Fig. 11e, one embodiment of the cable cover 198 includes a top cover 202 with two sidewalls 204 protruding therefrom. A far end of each sidewall 204 has a catch 206 formed thereon so as to engage with the cable channel aperture 196. As one skilled in the art would know, numerous other methods are available for removably attaching the cable cover 198 and the cable channel aperture that are well within the scope of the current invention.

With reference to Figs. 12a, 12b, 13a and 13b, the forearm extension 110 includes a body 140, which is preferably U-shaped so that a cable can be hidden therein, having female couplings 142, 144 disposed at each end. The U-shaped body 140 includes a topwall 207 and two side walls 208. The female coupling 142 has an inner diameter 209 that is sized to rotatably engage the shaft 114 of the second endcap 108. As illustrated in Fig. 8,

the forearm extension 110 and the shaft 114 are securely fastened to each other by connecting a screw 211 through a coupling top 213 into a hole 215 (Fig. 9a) within the shaft 114.

A bushing 210 (Fig. 8) is preferably used to engage the female coupling 142 and the shaft 114. That is, the bushing 210 is placed over the shaft 114 and within the female coupling 142. The bushing 210 is preferably made of a smooth material, such as plastic, in order to reduce friction and prevent metal to metal contact. The female coupling 142 preferably has a set screw 212 formed within a wall 214 of the female coupling 142. The set screw 212 is aligned to press against the bushing 210 at approximately the location of a ridge 216 (see Fig. 9a) on the shaft 114 of the second endcap 108. When the set screw 212 is tightened it causes the bushing 210 to flex inward and frictionally engage the shaft 114 and thus prevent the forearm extension 110 from rotating about the shaft 114. Advantageously, the female coupling 142 has a plurality of voids 217 formed in the wall 214, which saves on material costs and permits the forearm extension 110, when cast, to be cooled more quickly. The quicker cooling enables the production quantity to be increased.

The female coupling 144 has an inner diameter 218 that is sized to rotatably engage a shaft of a device mount, such as a tilter, platform or other device used to secure flat-screen devices. A bushing 220 (Fig. 8), preferably made of a smooth material such as plastic, is placed over the shaft and within the female coupling 144. The female coupling 144 preferably has a set screw 222 formed within a wall 224 of the female coupling

144. When the set screw 222 is tightened it causes the bushing 220 to flex inward and frictionally engage the shaft and thus prevent the device mount from rotating around the female coupling 144. Advantageously, the female coupling 144 also has a plurality of voids 226 formed in the wall 224.

Figs. 12a and 12b illustrate one embodiment of the forearm extension 110, wherein the center of the female couplings 142, 144 are aligned with a longitudinal centerline 228 of the body 140. As illustrated in Fig. 12b, when the axial centerlines of the female couplings 142, 144 are vertically disposed, the body 140 inclines at an angle, such as a 15 degree angle as specifically illustrated in Fig. 12b. It should be noted however that the incline angle is not limited to 15 degrees, and there may in fact be no incline at all in this embodiment.

Figs. 13a and 13b illustrate another embodiment of the forearm extension 110, wherein the center of the female couplings 142, 144 do not align with the axial centerline 228 of the body 140. Rather the body 140 is flush with an upper edge of the female coupling 142, resulting in the center of the female coupling 142 being offset from the center of the female coupling 144. As illustrated in Fig. 13b, when the axial centerlines of the female couplings 142, 144 are vertically disposed, the body 140 is horizontally disposed therebetween. It should be noted however that the body 140 is not limited to be horizontally disposed and may be disposed at an incline in this embodiment.

In addition to improvements in manufacturing and assembly, the present invention also offers a functional

interchangeability which is not present in the prior art. For instance, several forearm extensions 110 and/or extension arms 100 can be connected end-to-end to provide additional extension length or additional adjustability.

A dual purpose of flat-screen devices is to minimize the amount of space which they occupy while simultaneously being aesthetically pleasing to the eye. Thus, it is desirable that an extension arm for a flat-screen device be able to be mounted substantially flat to its mounting surface while hiding the extension arm behind it. The present invention permits a flat-screen device which is mounted to a wall to be flattened against the wall while hiding the extension arm 100 within the shadow of the device.

The prior art extension arms 10 did not allow this functionality. Referring to Figure 1, if a wall is defined by the plane of the page, it can be seen that a device inserted into the hole 26 may be substantially flattened against the wall when the upper and the lower channels 14, 16 and the forearm extension 20 are flush against the wall. A flat-screen computer monitor, which is typically about 15 inches wide, will hide from view the forearm extension 20, but may leave exposed the parallelogram formed by the first endcap 12, the upper channel 14, the lower channel 16 and the second endcap 18. In order to hide the parallelogram, the forearm extension 20 needs to be rotated about the forearm extension pin 92 toward the first endcap 12. However, the upper and the lower channels 14, 16 and the first endcap 12 will prevent the forearm extension 20 from being flush against the wall in this configuration. Thus, it is

clear that the prior art extension arms 10 could only provide the ability to mount a device flush to the wall or the ability to mount a device so as to hide the forearm extension 20, but not both.

By contrast, the upper and the lower channels 104, 106 of the present invention do not interfere with the rotation of the forearm extension 110. That is, the forearm extension 110 may be folded into a position which is directly above the upper and the lower channels 104, 106. As a result, the mounted device is flush to the mounting surface and substantially hides the parallelogram, formed by the first and the second endcaps 102, 108 and the upper and the lower channels 104, 106, as well as the forearm extension 110 from view. Thus, the aesthetic appeal of the extension arm 100 is increased and the space occupied by the extension arm 100 and the device is minimized.

In an alternative embodiment, as illustrated in Figs. 14 and 15, the extension arm 100 has a built in cable management system so that cables to and from the device can be hidden within the extension arm 100. In this embodiment, the lower channel 106, the second endcap 108 and the forearm extension 110 are modified as discussed below to permit cables to travel therewithin.

As illustrated in Fig. 16, he cable channel 196 running longitudinally along the channel bottom 190 of the lower channel 106 has a first end 197 that starts near an end of the channel bottom 190 that pivotably connects to the first endcap 102. The cable channel 196 then runs along the entire length of the channel bottom 190 to the end of the channel bottom 190 that

pivotably connects to the second endcap 108. Thus, the second end 199 of the cable channel 196 is an opening between the roller 136 at the end of the channel bottom that pivotably connects to the second endcap 108. The first end 197 may be, for example, rounded to improve the rigidity of the lower channel 106. As discussed previously, the cable channel 196 is configured to receive a cable cover 198 (illustrated in Fig. 12e) which is configured to removably fit within the cable channel 196. Thus, cables of the mounted device may be substantially retained within the lower channel 106 so as to hide them from view and protect them from harm. The cable channel 196 and the cable cover 198 enable cables to be accessed when desired, while securing them within the lower channel 106.

As illustrated in Figs. 17a-c, the second endcap 108 includes a partially enclosed housing 250 and a shaft assembly 252. The partially enclosed housing 250 has a first endwall 254 and a second endwall 256 oppositely-disposed from each other and fixedly connected by a sidewall 258. The sidewall 258 extends partially around the partially-enclosed housing 250 so as to permit manipulation of components, such as cables, which may be contained therewithin. The first endwall 254 has a hole 260 disposed therethrough and threaded holes 262 disposed therein that are in communication with the hole 260. Disposed with the threaded holes 262 are set screws 264. Preferably, the diameter of the hole 260 is large enough to allow a plug end of a cable to fit therethrough.

As illustrated in Figs. 18a-c, the shaft assembly 252 preferably includes two symmetrical endcap adapters 266 which

when assembled provide a hollow shaft 268. The endcap adapters 266 have a mounting end 270 and a shaft end 272 that is thinner than the mounting end 270. As illustrated in Fig. 19, the mounting end 270 of both of the endcap adapters 266 are inserted into the hole 260 and are coupled together and to the partially enclosed housing 250, to form the second endcap 108, by tightening the set screws 264.

With reference to Figs. 20a-b, the forearm extension 110 includes a body 140 having a first female coupling 142 located on a first end and a second female coupling 144 located on a second end. The first female coupling 142 has an inner diameter 209 that is sized to rotatably engage the hollow shaft 268 of the second endcap 108. The first female coupling 142 is also configured to receive a cable through the hollow shaft 268. That is, the first female coupling 142 has a cable slot 274 formed therein, for example by milling the cable slot 274 into the first female coupling 142, or by casting the first female coupling 142 with the cable slot 274 integrally formed therein. As illustrated in Figs. 21a-b, the bushing 210 also has a cable slot 276 formed therein. The cable slots 274, 276 are aligned so that a cable can pass therethrough.

Referring back to Fig. 14, a flat screen monitor 300 is attached to a tilter 302 which is rotatably coupled to the second female coupling 144. A cable 304, such as a power cable, proceeds from the monitor 300 to the underside off the U-shaped body 140 of the forearm extension 110. The cable 304 is held in place within the U-shaped body 140 by the cable holder 278. The cable 304 proceeds from the body through the cable slots 274,

276 in the bushing 210 and the first female coupling 142. The cable then proceeds through the hollow shaft 268 of the second endcap 108. The cable exits the second endcap 208 through the open end of the partially enclosed housing 260. The cable proceeds down the length of the lower channel 106 and exits at the first end 197 of the cable channel 196.

Preferably, the cable 304 is inserted into the extension arm 100 as portions of the extension arm 100 are being assembled. That is, the cable 304 is placed under the U-shaped body 140 of the forearm extension 110 and is held in place by the cable holder 278. The cable is then passed through the cable slots 274, 276. The cable 304 including the plug 306 is then fed through the hole 260 in the second endcap 108. The second endcap 108 is now assembled by inserting the mounting end 270 of each endcap adapter 268 into the hole 260, thus surrounding the cable 304. The endcap adapters 268 are held together and within the hole 260 by tightening the set screws 264. The hollow shaft 268 is then placed within the first female coupling 142. The cable 304 is placed within the lower channel 106, prior to the lower channel 106 and the second endcap being secured together. This ensures that the cable 304 is above the roller 136 and is contained within the hollow bar formed by the upper channel 104 and the lower channel 106.

Referring back to Fig. 15, several additional components of the extension arm 100 are discussed. For aesthetic purposes, a bumper 280 may be placed on the second endwall 256 of the second endcap 108 and a plug 282 may be placed over the first female coupling 142. A washer 284 may be placed over the two endcap

adapters 268 to help secure them together.

Although this invention has been illustrated by reference to specific embodiments, it will be apparent to those skilled in the art that various changes and modifications may be made that clearly fall within the scope of the invention. The invention is intended to be protected broadly within the spirit and scope of the appended claims.

What is claimed is:

1. An extension arm for adjustably mounting a device to a support mount, said extension arm comprising:

a forearm extension having a first end for attachment to the device and a second end;

a first endcap including a first endcap body and a first endcap shaft, said first endcap shaft pivotably attached to the support mount;

a second endcap including a second endcap body and a second endcap shaft, said second endcap shaft pivotably attached to the second end of said forearm extension;

an upper channel having a first end, a second end, a first roller disposed on the first end and configured to be pivotably attached to said first endcap, and a second roller disposed on the second end and configured to be pivotably attached to said second endcap;

a lower channel having a first end, a second end, a third roller disposed on the first end and configured to be pivotably attached to said first endcap, and a fourth roller disposed on the second end and configured to be pivotably attached to said second endcap; and

a gas spring rotatably attached at a first end to said upper channel and adjustably attached at a second end to said first endcap, wherein said gas spring is configured to retain said upper channel, said lower channel, said first endcap and said second endcap in a parallelogram shape when the device is positioned.

2. The extension arm of claim 1, wh
rollers of said upper channel are integrally cast with said upper channel so as to be an integral part of said upper channel and all of said rollers of said lower channel are integrally cast with said lower channel so as to be an integral part of said lower channel.

3. The extension arm of claim 1, wherein said first endcap further includes:

a clevis pivotably attached to the second end of said gas spring; and

a rod in threaded engagement with said clevis, wherein said clevis is configured to slide within said first endcap when said rod rotates around its axial centerline.

4. The apparatus according to claim 3, wherein said first endcap body has a hole formed in a side thereof and a first end of said rod is inserted through said hole.

5. The extension arm of claim 4, wherein the first end of said rod has a shaped opening and is configured to rotate around its axis when a shaped key is inserted in said shaped opening and is turned.

6. The extension arm of claim 5, wherein said rod has a shoulder adjacent to the first end, said shoulder having a diameter larger than a diameter of said hole in said first

first endcap body and retains the first er
hole.

7. The extension arm of claim 6, wherein said first endcap further includes a pair of shelves disposed in said first endcap body adjacent to the first end, said pair of shelves separated by a groove.

8. The extension arm of claim 7, wherein each of said pair of shelves includes a self tapping screw hole disposed therein.

9. The extension arm of claim 8, wherein a second end of said rod is rotatably secured within said groove in said first endcap, and is retained in place by a retainer clip fastened to said shelves.

10. The extension arm of claim 1, wherein said upper channel has a threaded hole formed therein.

11. The extension arm of claim 10, wherein the second end of said gas spring is rotatably mounted to said upper channel via a ball stud threadedly mounted in said threaded hole in said upper channel.

12. The extension arm of claim 10, wherein said threaded hole is integrally cast with said upper channel so as to be an

13. The extension arm of claim 1, wherein said first end cap and said second endcap are fabricated from a zinc material.

14. The extension arm of claim 1, wherein said first endcap and said second endcap are cast molded.

15. The extension arm of claim 1, wherein said first endcap and said second endcap are made via interlocking molding.

16. The extension arm of claim 1, wherein the device is a flat-screen device.

17. The extension arm of claim 16, wherein said extension arm is configured so as to be substantially hidden behind the flat-screen device when the flat-screen device is positioned flat against a mounting surface.

18. The extension arm of claim 1, wherein a lower surface of said lower channel has a cable channel aperture formed therein.

19. The extension arm of claim 1, wherein said first endcap body and said second endcap body further include stops located therein, the stops located proximate to a first end and a second end.

endcap body and said second endcap body fu
of trough walls therein, the pair of trough walls forming a trough therebetween.

21. The extension arm of claim 1, wherein said upper channel, said lower channel, said first endcap and said second endcap are pivotably attached in such a manner that said first endcap shaft and said second endcap shaft face opposite directions.

22. An extension arm for adjustably mounting a device to a support mount, said extension arm comprising:

a forearm extension having a first end for attachment to the device and a second end;

a first endcap pivotably attached to the support mount;

a second endcap pivotably attached to the second end of said forearm extension;

an upper channel having a first roller at a first end and a second roller at a second end, wherein said rollers are integrally cast with said upper channel, said first roller configured to be pivotably attached to said first endcap and said second roller configured to be pivotably attached to said second endcap;

a lower channel having a third roller at a first end and a fourth roller at a second end, wherein said rollers are integrally cast with said lower channel, said third roller configured to be pivotably attached to said first endcap and

second endcap; and

a gas spring rotatably attached at a first end to said upper channel and adjustably attached at a second end to said first endcap, wherein said gas spring is configured to retain said channels and said endcaps in a parallelogram shape when the device is positioned.

23. The extension arm of claim 22, wherein a lower surface of said lower channel has a cable channel aperture formed therein.

24. The extension arm of claim 23, further comprising a cover that is removably attachable to said cable channel aperture.

25. The extension arm of claim 22, wherein said first endcap includes a first endcap body and a first endcap shaft, said first endcap shaft pivotably attached to the support mount, and said second endcap includes a second endcap body and a second endcap shaft, said second endcap shaft pivotably attached to the second end of said forearm extension.

26. The extension arm of claim 22, wherein said upper channel has a threaded hole formed therein.

27. The extension arm of claim 26, wherein the second end of said gas spring is rotatably mounted to said upper

in said upper channel.

28. The extension arm of claim 26, wherein said threaded hole is integrally cast with said upper channel so as to be an integral part of said upper channel.

29. An endcap for use in an extension arm that adjustably mounts a device to a support mount, said endcap comprising:

a partially enclosed housing having a first endwall, a second endwall and at least one sidewall, said first endwall having a hole contained therein;

a shaft connected to said second endwall; and

a pair of shelves disposed within said partially enclosed housing adjacent to said second endwall, said pair of shelves forming a groove therebetween.

30. The endcap of claim 29, further comprising stops located within said partially enclosed housing proximate to said first endwall and said second endwall.

31. The endcap of claim 29, further compromising a pair of trough walls formed within said partially enclosed housing, said pair of trough walls forming a trough therebetween.

32. The endcap of claim 29, further compromising:

a clevis having a hole therein;

clevis is configured to slide within said rotates around its axial centerline.

33. The endcap of claim 32, wherein said rod includes a first end having a shaped opening, a shoulder adjacent to the first end, a threaded portion, and a second end.

34. The endcap of claim 33, wherein the first end of said rod is located within said hole in said first endwall, and said shoulder of said rod abuts an inner surface of said first endwall.

35. The endcap of claim 33, wherein said rod is configured to rotate around its axis when a shaped key is inserted in said shaped opening and is turned.

36. The endcap of claim 33, wherein the second end of said rod is rotatably secured within said groove and is retained in place by a retainer clip fastened to said shelves.

37. The endcap of claim 29, wherein said partially enclosed housing, said shaft, and said pair of shelves are fabricated from a zinc material.

38. The endcap of claim 29, wherein said partially enclosed housing, said shaft and said pair of shelves are cast molded.

39. The endcap of claim 29, where enclosed housing, said shaft and said pair of shelves are made via interlocking molding.

40. An upper channel for use in an extension arm that adjustably mounts a device to a support mount, said upper channel comprising a body having a first roller at a first end and a second roller at a second end, wherein said body and said rollers are integrally cast.

41. The upper channel of claim 40, wherein said body includes a threaded hole formed therein.

42. The upper channel of claim 41, wherein said threaded hole is integrally cast with said body and said rollers.

43. The upper channel of claim 41, further comprising a ball stud threadedly mounted to said threaded hole.

44. The upper channel of claim 40, wherein said body and said rollers are fabricated from a zinc material.

45. The upper channel of claim 40, wherein said body and said rollers are cast molded.

46. The upper channel of claim 40, wherein said body

47. A lower channel for use in an extension arm that adjustably mounts a device to a support mount, said lower channel comprising a body having a first roller at a first end and a second roller at a second end, wherein said body and said rollers are integrally cast.

48. The lower channel of claim 47, wherein a lower surface of said body has a cable channel aperture formed therein.

49. The lower channel of claim 48, further comprising a cover that is removably attachable to said cable channel aperture.

50. The lower channel of claim 47, wherein said body and said rollers are fabricated from zinc material.

51. The lower channel of claim 47, wherein said body and said rollers are cast molded.

52. The lower channel of claim 47, wherein said body and said rollers are made via interlocking molding.

53. A method of forming an extension arm that adjustably mounts a device to a support mount, the method comprising:

and a threaded hole therein;

forming a lower channel that includes a roller at each end;

forming two identical endcaps having

a partially enclosed housing having a first endwall, a second endwall and at least one sidewall, wherein the first endwall contains a hole therein, and the second endwall has a shaft connected thereto, and

a pair of shelves disposed within the partially enclosed housing near the second endwall, the pair of shelves forming a groove therebetween;

forming a rod including a fist end having a shaped opening, a shoulder adjacent to the first end, a threaded portion, and a second end;

threading the rod through a hole in a clevis;

placing the first end of the rod within the hole in the first endwall of a first one of the endcaps until the shoulder abuts an inner surface of the first endwall;

placing the second end of the rod within the groove in the first endcap;

securing the second end of the rod by placing a retainer over the rod and connecting the retainer to the shelves;

forming a forearm extension having a body, a first end for connecting to a second one of the endcaps and a second end for connecting to the device;

threadedly mounting a ball stud in the threaded hole of the upper channel;

connecting one end of a gas spring to the ball stud and a

clevis;

attaching the upper channel, the lower channel, the first endcap and the second endcap to form a parallelogram; and

connecting the first end of the forearm extension and the shaft of the second endcap.

54. The method of claim 53, wherein the upper channel, the lower channel, the first endcap and the second endcap are attached in a manner such that the shaft of the first endcap and the shaft of the second endcap face opposite directions.

55. The method of claim 53, wherein said forming an upper channel includes integrally casting the upper channel including the rollers and the threaded hole contained therein.

56. The method of claim 55, wherein said integrally casting the upper channel includes integrally casting the upper channel from zinc.

57. The method of claim 53, wherein said forming a lower channel includes integrally casting the lower channel including the rollers.

58. The method of claim 57, wherein said integrally casting the lower channel includes integrally casting the lower channel from zinc.

lower channel includes forming a lower cha
each end and a cable channel aperture in a lower surface.

60. The method of claim 59, further comprising placing a cover within the cable channel aperture.

61. The method of claim 53, wherein said forming two identical endcaps includes integrally casting the two identical endcaps including the partially enclosed housing, the shaft, and the pair of shelves disposed within the partially enclosed housing.

62. The method of claim 61, wherein said integrally casting the two identical endcaps includes integrally casting the two identical endcaps from zinc.

63. A method of forming an extension arm that adjustably mounts a device to a support mount, the method comprising:

integrally casting an upper channel that includes a roller at each end and a threaded hole contained therein;

integrally casting a lower channel that includes a roller at each end;

forming a first endcap including a clevis;

forming a second endcap;

forming a forearm extension having a body, a first end for connecting to the second endcap and a second end for connecting

threadedly mounting a ball stud in th upper channel;

connecting one end of a gas spring to the ball stud and a second end of the gas spring to a fastening member of the clevis;

attaching the upper channel, the lower channel, the first endcap and the second endcap to form a parallelogram; and

connecting the first end of the forearm extension and the second endcap.

64. The method of claim 63, wherein said forming the first endcap includes

forming a partially enclosed housing having a first endwall, a second endwall and at least one sidewall, wherein the first endwall contains a hole therein, and the second endwall has a shaft connected thereto;

forming a pair of shelves disposed within the partially enclosed housing near the second endwall, the pair of shelves forming a groove therebetween;

forming a rod including a fist end having a shaped opening, a shoulder adjacent to the first end, a threaded portion, and a second end;

threading the rod through a hole in the clevis;

placing the first end of the rod within the hole in the first endwall until the shoulder abuts an inner surface of the first endwall;

placing the second end of the rod within the groove; and

over the rod and connecting the retainer t

65. The method of claim 63, wherein said forming the second endcap includes

forming a partially enclosed housing having a first endwall, a second endwall and at least one sidewall, wherein the first endwall contains a hole therein, and the second endwall has a shaft connected thereto; and

forming a pair of shelves disposed within the partially enclosed housing near the second endwall, the pair of shelves forming a groove therebetween.

66. The method of claim 63, wherein said integrally casting the upper channel includes integrally casting the upper channel from zinc.

67. The method of claim 63, wherein said integrally casting the lower channel includes integrally casting the lower channel from zinc.

68. The method of claim 63, wherein said forming a lower channel includes forming the lower channel with the roller at each end and a cable channel aperture in a lower surface.

69. The method of claim 63, further comprising placing a cover within the cable channel aperture.

arm that adjustably mounts a device to a s

method comprising forming two partially enclosed housings, each housing having a first endwall with a hole formed therein, a second endwall with a shaft connected thereto, at least one sidewall, and a pair of shelves disposed within the partially enclosed housing adjacent to the second endwall, the pair of shelves forming a groove therebetween.

71. The method of claim 70, further comprising

forming a rod including a fist end having a shaped opening, a shoulder adjacent to the first end, a threaded portion, and a second end;

threading the rod through a hole in a clevis;

placing the first end of the rod within the hole in the first endwall of a first one of the partially enclosed housings until the shoulder abuts an inner surface of the first endwall;

placing the second end of the rod within the groove in the first one of the partially enclosed housings; and

securing the second end of the rod by placing a retainer over the rod and attaching the retainer to the shelves.

72. The method of claim 70, wherein said forming two partially enclosed housings includes integrally casting the two partially enclosed housings including the endwalls, the shaft, the at least one sidewall, and the pair of shelves.

73. The method of claim 72, wherein said integrally

casting the two partially enclosed housing

74. The method of claim 70, wherein said forming two partially enclosed housings includes forming the two partially enclosed housings each having stops located within the partially enclosed housings adjacent to the first endwall and the second endwall.

75. The method of claim 70, wherein said forming two partially enclosed housings includes forming the two partially enclosed housings each having a pair of trough walls within the partially enclosed housings, the pair of trough walls forming a trough therebetween.

76. A method of forming channels for use in an extension arm that adjustably mounts a device to a support mount, the method comprising:

integrally casting an upper channel that includes a roller at each end and a threaded hole formed therein; and

integrally casting a lower channel that includes a roller at each end.

77. The method of claim 76, wherein said integrally casting the upper channel includes integrally casting the upper channel from zinc.

78. The method of claim 76, wherein said integrally

channel from zinc.

79. The method of claim 76, wherein said integrally casting a lower channel includes integrally casting the lower channel with the rollers and a cable channel aperture in a lower surface.

80. The method of claim 79, further comprising placing a cover within the cable channel aperture.

81. The method of claim 76, further comprising threadedly mounting a ball stud in the threaded hole of the upper channel.

82. An extension arm for adjustably mounting a device to a support mount and hiding cables to and from the device within said extension arm, said extension arm comprising:

a forearm extension having a body, means for attachment to the device disposed at a first end of said body, and a coupling disposed at a second end, said second end coupling having a cable slot formed in a wall thereof so that said second end coupling and said body are in communication with each other through said cable slot;

a first endcap including a support shaft pivotably attached to the support mount;

a second endcap including a partially enclosed housing and a hollow shaft, said hollow shaft pivotably attached to said

an upper channel having a first roll
end and configured to be pivotably attached to said first endcap, and a second roller disposed at a second end and configured to be pivotably attached to said second endcap;

a lower channel having a third roller disposed at a first end and configured to be pivotably attached to said first endcap, a fourth roller disposed at a second end and configured to be pivotably attached to said second endcap, and a cable channel formed therein that runs longitudinally along said lower channel from a point close to the first end of said lower channel to the second end of said channel so as to cut through said fourth roller and form an opening in the second end of said lower channel; and

a gas spring rotatably attached at a first end to said upper channel and adjustably attached at a second end to said first endcap, wherein said gas spring is configured to retain said upper channel, said lower channel, said first endcap and said second endcap in a parallelogram shape when the device is positioned.

83. The extension arm of claim 82, wherein a cable from the device is disposed within said extension arm starting at said body of said forearm extension and proceeding through said cable slot into said second end coupling, through said second end coupling into said hollow shaft, through said hollow shaft into said partially enclosed housing, through said partially enclosed housing into said lower channel, and through said lower

84. The extension arm of claim 82, wherein said upper channel, said lower channel, said first endcap and said second endcap are pivotably attached in such a manner that said support shaft and said hollow shaft face opposite directions.

85. The extension arm of claim 82, further comprising a cable cover that is removably attachable to said cable channel.

86. The extension arm of claim 82, wherein said partially enclosed housing includes a first endwall, a second endwall and at least one sidewall, said first endwall having a endwall hole contained therein.

87. The extension arm of claim 82, wherein said hollow shaft includes two symmetrical endcap adapters connected together.

88. The extension arm of claim 87, wherein each of said symmetrical endcap adapters have a semicircular cross sectional profile.

89. The extension arm of claim 86, wherein said hollow shaft has a portion with a first diameter and a portion with a second diameter that is greater than the first diameter.

90. The extension arm of claim 89, wherein the second

of said endwall hole.

91. The extension arm of claim 89, wherein said portion of said hollow shaft with the second diameter is inserted into said endwall hole.

92. The extension arm of claim 86, wherein said first endwall further includes threaded holes that are in communication with said endwall hole.

93. The extension arm of claim 92, further comprising fasteners that are inserted in said threaded holes so as to couple said hollow shaft and said partially enclosed housing.

94. The extension arm of claim 86, wherein said endwall hole is large enough so a plug of a cable can fit therethrough.

95. A second endcap for use in an extension arm that adjustably mounts a device to a support mount and hides cables to and from the device within said extension arm, said second endcap comprising:

a partially enclosed housing having a first endwall, a second endwall and at least one sidewall, said first endwall having a endwall hole contained therein; and

a shaft assembly having a shaft hole therethrough, said shaft assembly connected to said first endwall so that said shaft hole and said endwall hole are aligned so as to form a

96. The second endcap of claim 95, wherein said shaft assembly includes two symmetrical endcap adapters connected together to form a hollow shaft.

97. The second endcap of claim 96, wherein each of said symmetrical endcap adapters have a semicircular cross sectional profile.

98. The second endcap of claim 95, wherein said hollow shaft has a portion with a first diameter and a portion with a second diameter that is greater than the first diameter.

99. The second endcap of claim 98, wherein the second diameter of said hollow shaft is nearly the same as a diameter of said endwall hole.

100. The second endcap of claim 98, wherein said portion of said hollow shaft with the second diameter is inserted into said endwall hole.

101. The second endcap of claim 95, wherein said first endwall further includes threaded holes that are in communication with said endwall hole.

102. The second endcap of claim 101, further comprising fasteners that are inserted in said threaded holes so as to

103. The second endcap of claim 95, wherein said endwall hole is large enough so a plug of a cable can fit therethrough.

104. The second endcap of claim 95, wherein said at least one sidewall is semicircular in shape and connects to said first endwall and said second endwall.

105. The second endcap of claim 95, wherein said second endcap is fabricated from a zinc material.

106. The second endcap of claim 95, wherein said second endcap is cast molded.

107. The second endcap of claim 95, wherein said second endcap is manufactured via interlocking molding.

108. A lower channel for use in an extension arm that adjustably mounts a device to a support mount and hides cables to and from the device within said extension arm, said lower channel comprising:

a body;

a first roller disposed at a first end of said body;

a second roller disposed at a second end of said body; and

a cable channel formed therein that runs longitudinally along said lower channel from a point close to the first end of said lower channel to the second end of said channel so as to

end of said lower channel.

109. The lower channel of claim 108, further comprising a cable cover that is removably attachable to said cable channel.

110. The lower channel of claim 108, wherein said lower channel is fabricated from zinc material.

111. The lower channel of claim 108, wherein said lower channel is cast molded.

112. The lower channel of claim 108, wherein said lower channel is manufactured via interlocking molding.

113. A forearm extension for use in an extension arm that adjustably mounts a device to a support mount and hides cables to and from the device within said extension arm, said forearm extension compromising:

a body;

means for attachment to the device disposed at a first end of said body; and

a coupling disposed at a second end, said second end coupling having a slot formed in a wall thereof so that said coupling and said body are in communication with each other through said slot.

second end coupling has a set screw contai

115. The forearm extension of claim 113, wherein an inner surface of said second end coupling has a plurality of grooves formed therein.

116. The forearm extension of claim 113, wherein said means for attachment is a first end coupling.

117. The forearm extension of claim 116, wherein said first end coupling has a set screw contained in a sidewall.

118. The forearm extension of claim 116, wherein an inner surface of said first end coupling has a plurality of grooves formed therein.

119. The forearm extension of claim 113, wherein said body is U-shaped.

120. The forearm extension of claim 119, further compromising a cable holder within said U-shaped body.

FIG. 1
(PRIOR ART)

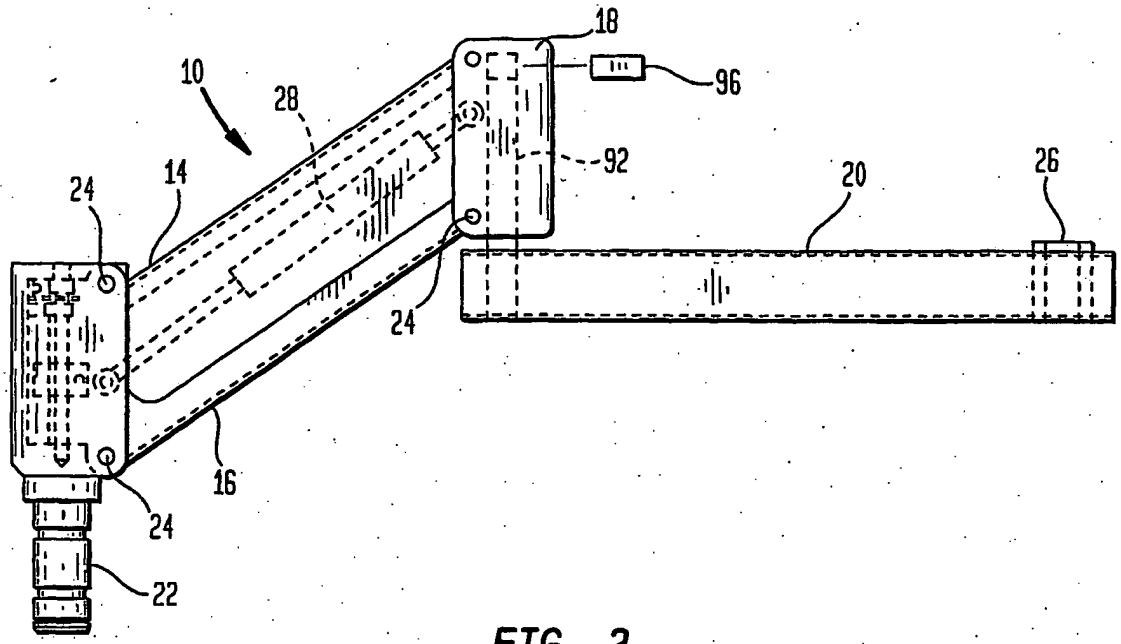


FIG. 2
(PRIOR ART)

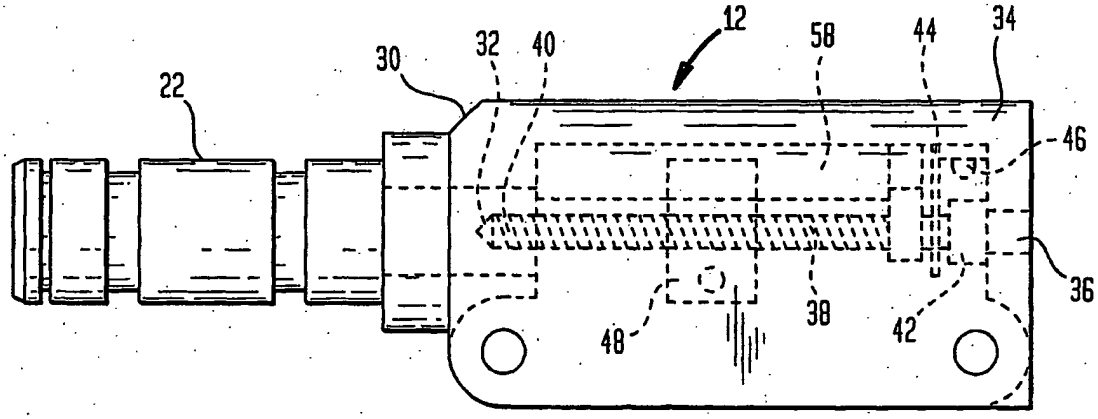


FIG. 3
(PRIOR ART)

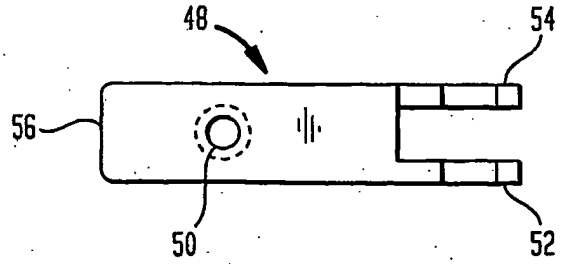


FIG. 4A
(PRIOR ART)

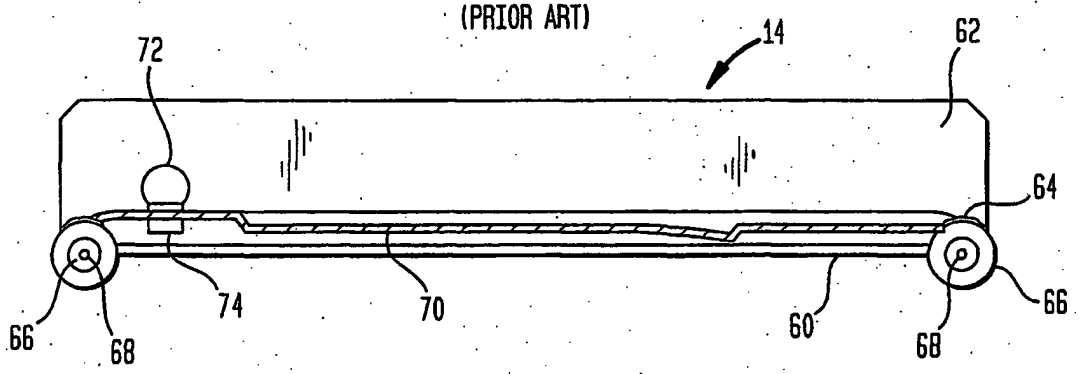


FIG. 4B
(PRIOR ART)

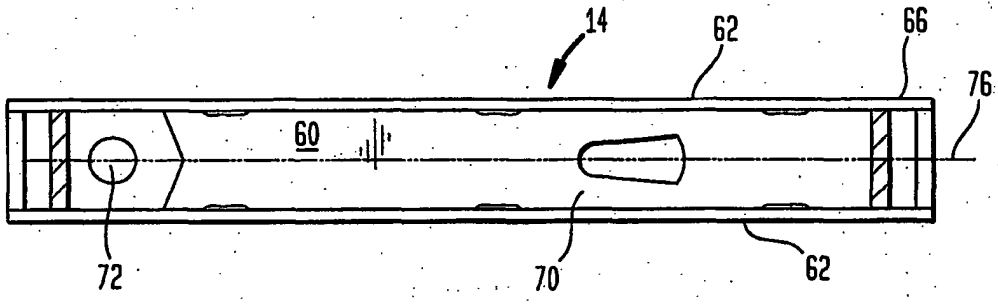


FIG. 5A
(PRIOR ART)

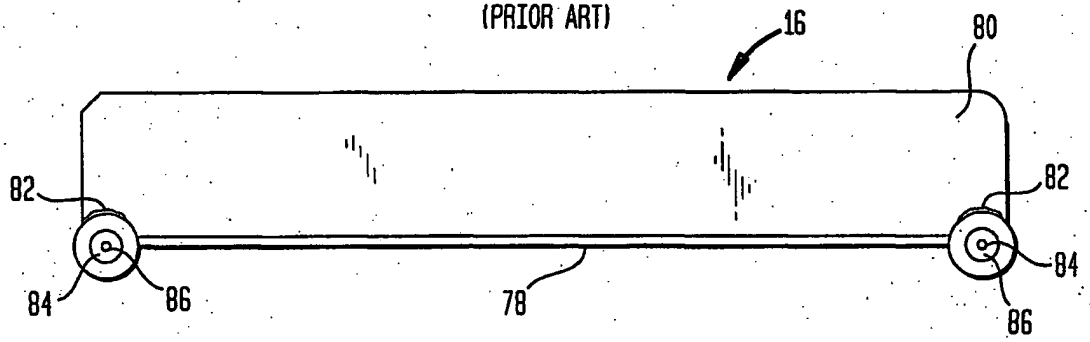


FIG. 5B
(PRIOR ART)

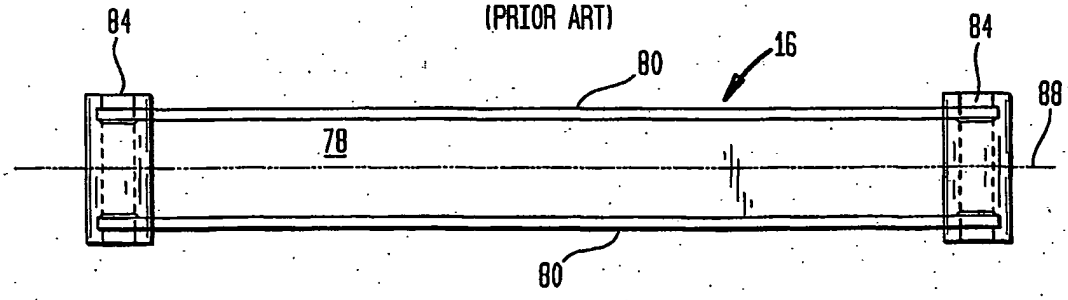


FIG. 6
(PRIOR ART)

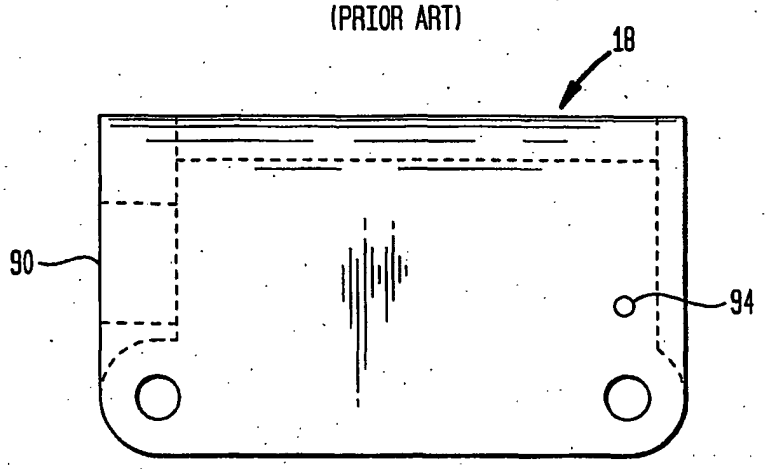


FIG. 7
(PRIOR ART)

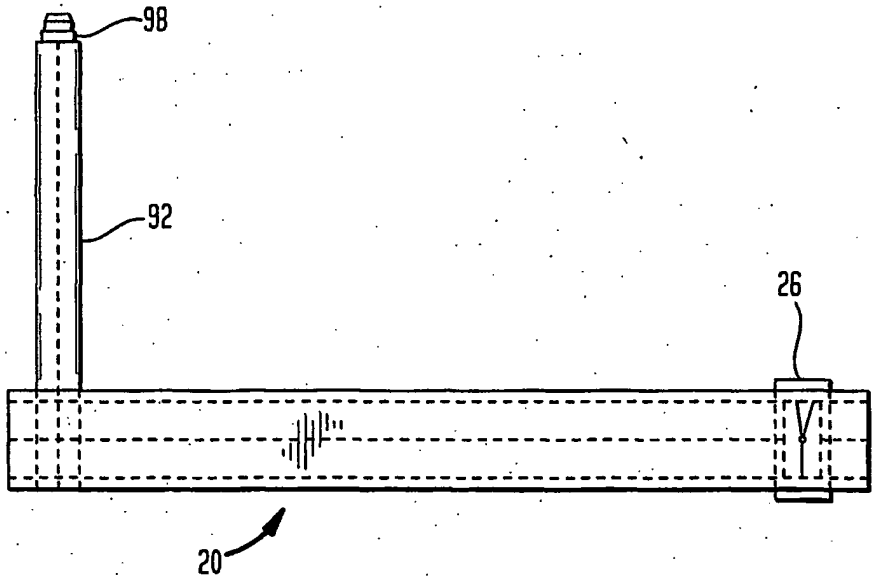


FIG. 8

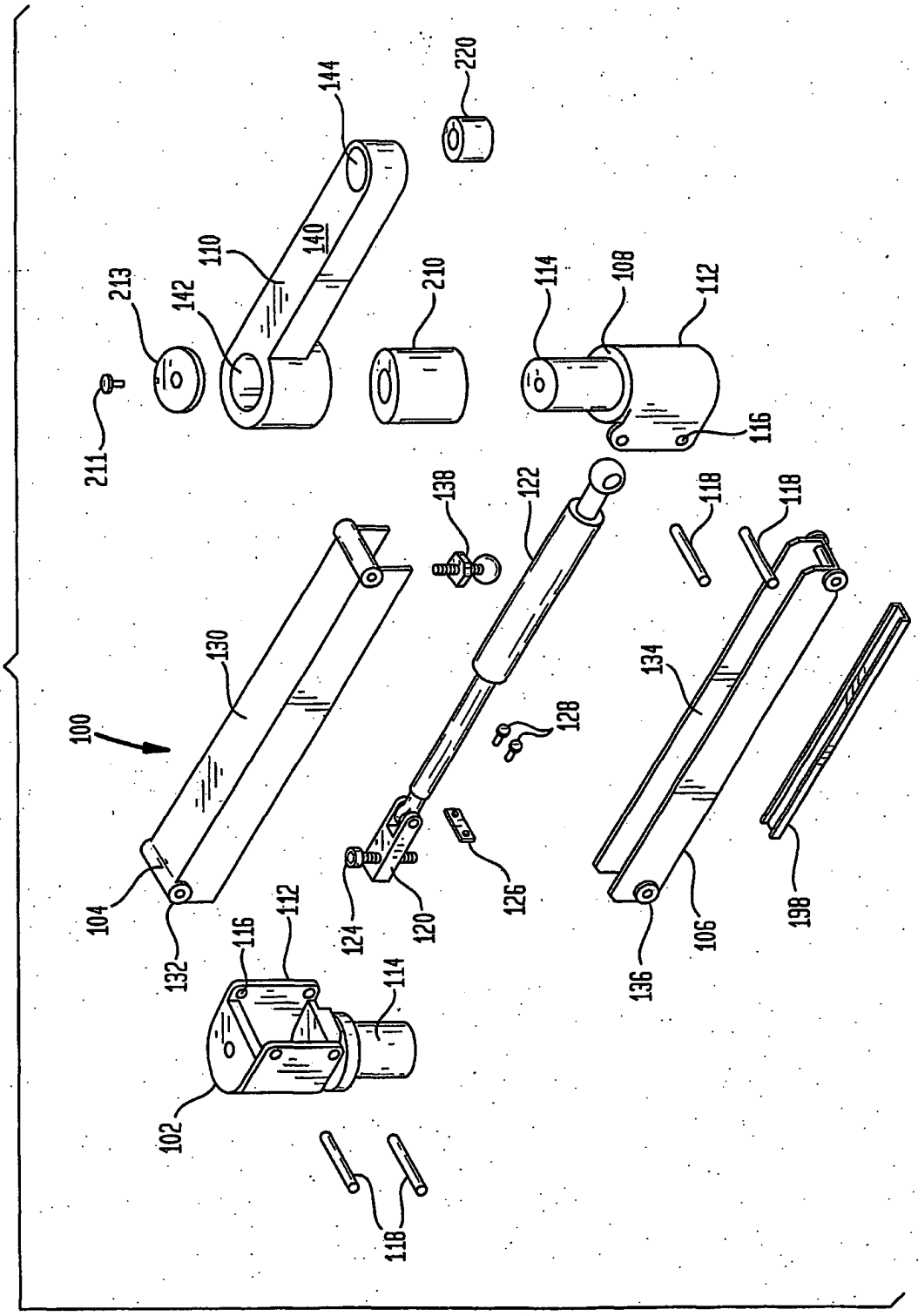


FIG. 9A

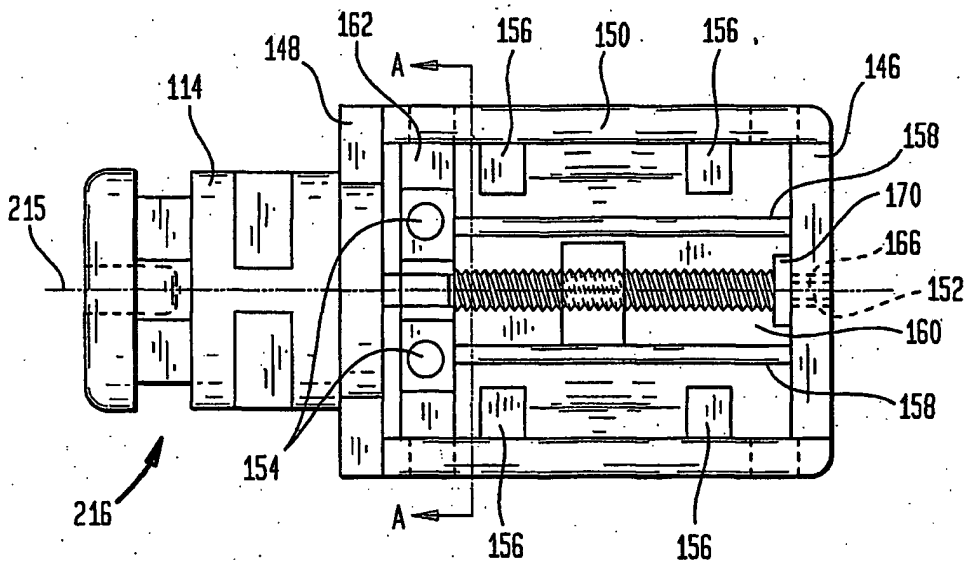


FIG. 9B

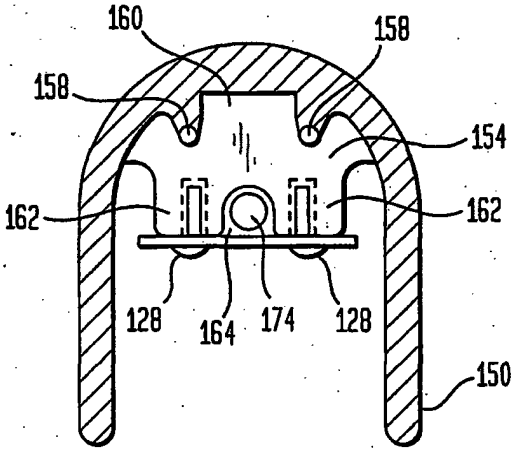


FIG. 9C

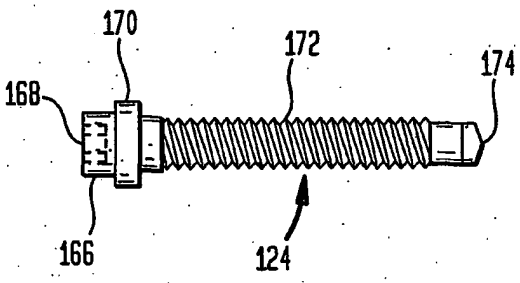


FIG. 9D

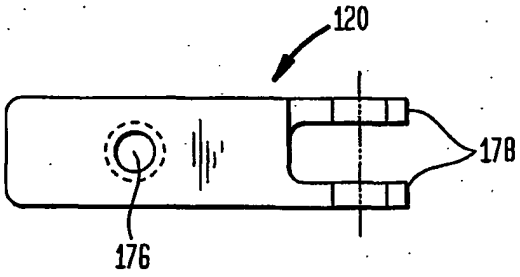


FIG. 10A

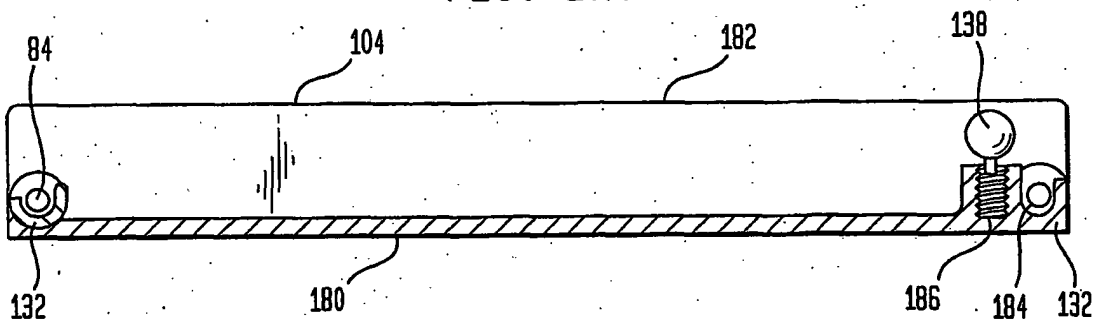


FIG. 10B

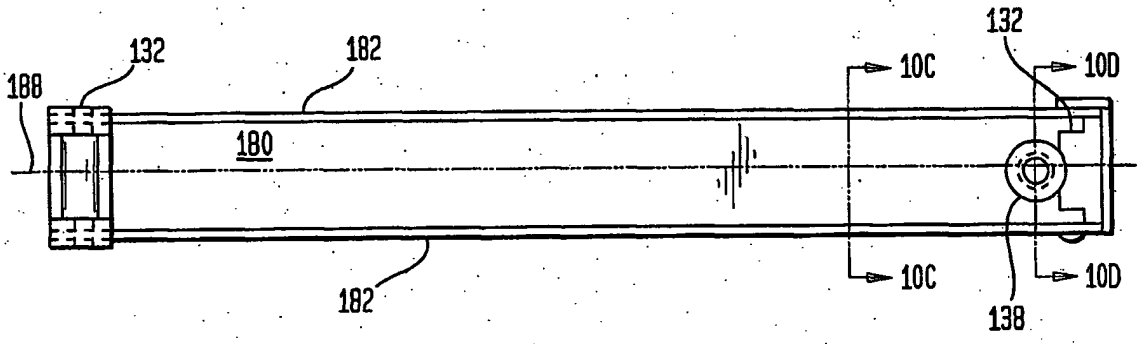


FIG. 10C

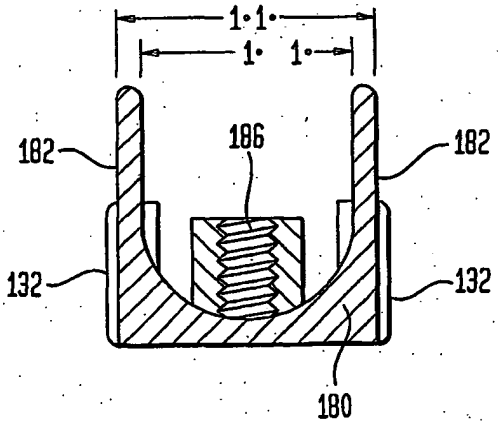
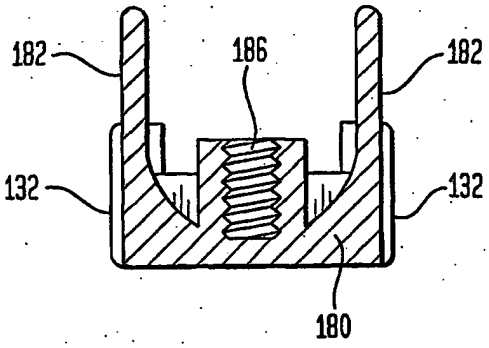


FIG. 10D



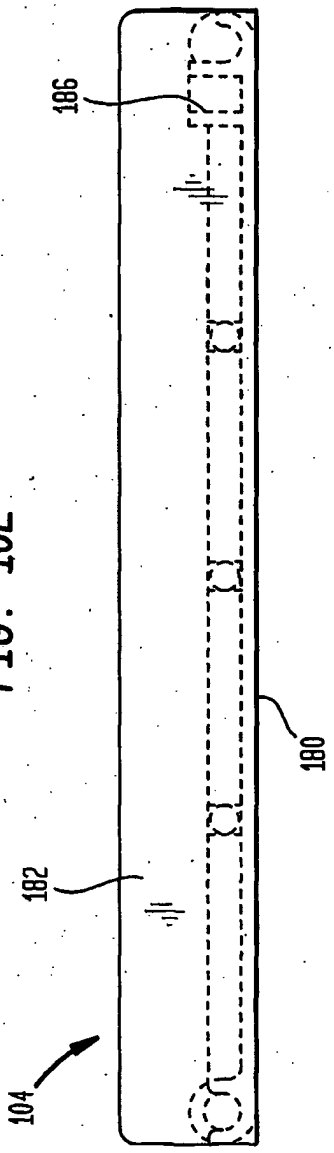


FIG. 10E

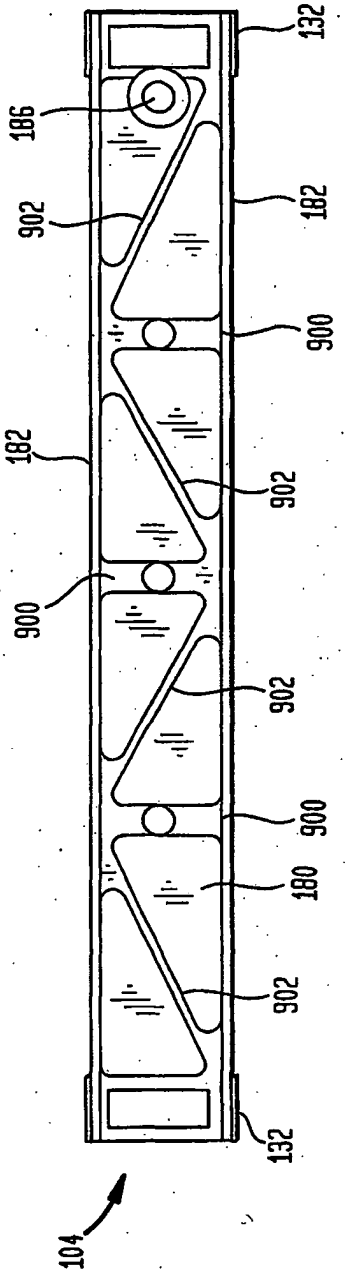


FIG. 10F

FIG. 11A

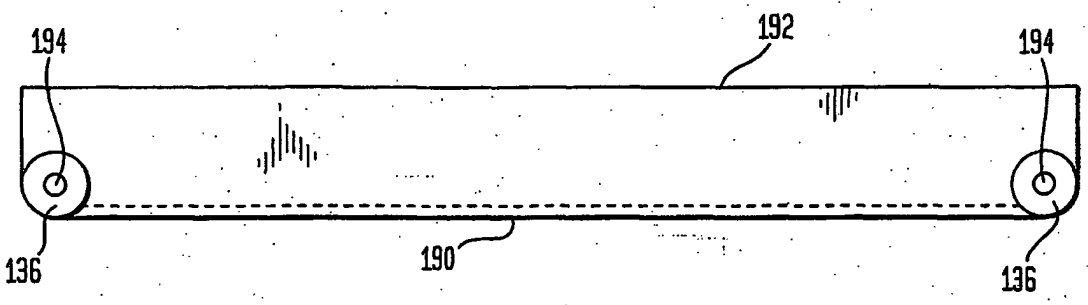


FIG. 11B

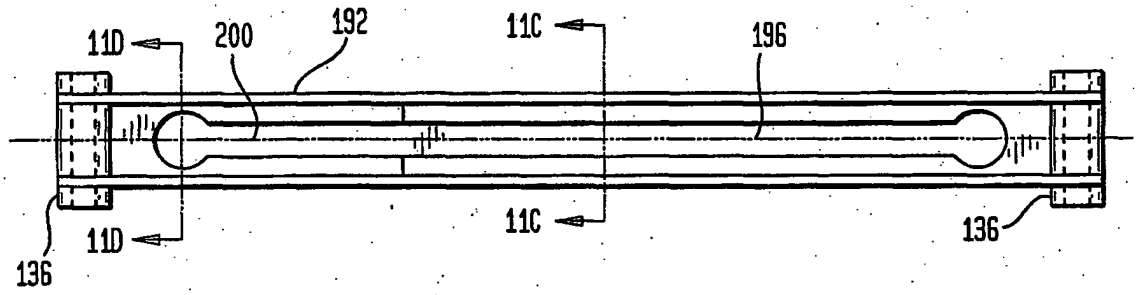


FIG. 11C

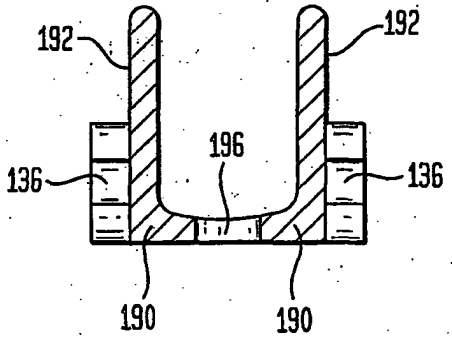


FIG. 11D

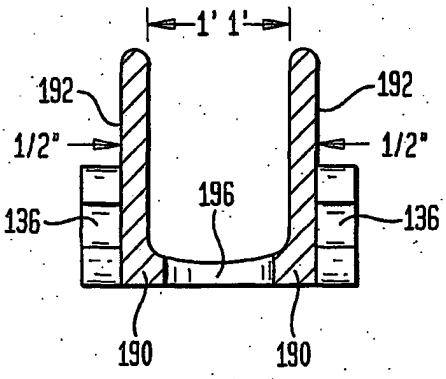


FIG. 11E

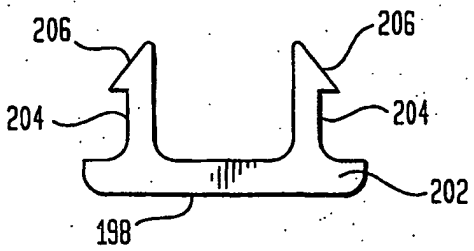


FIG. 12A

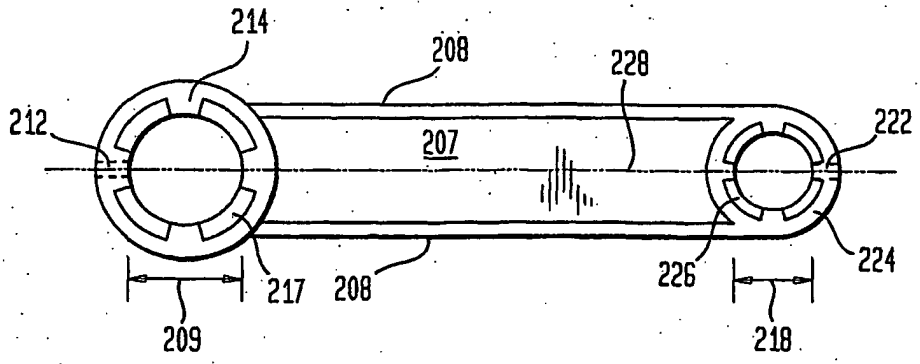


FIG. 12B

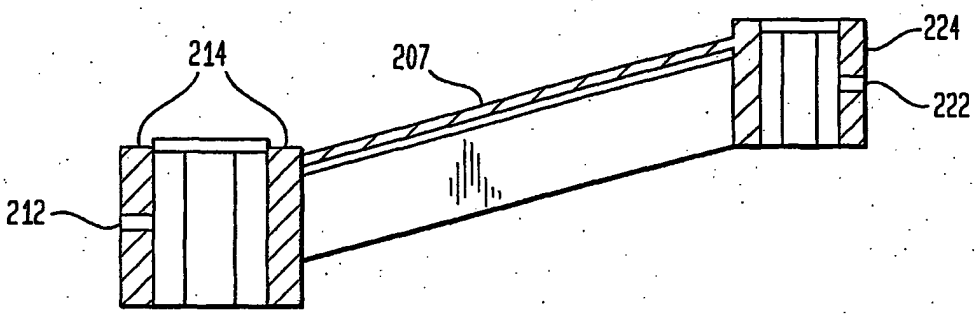


FIG. 13A

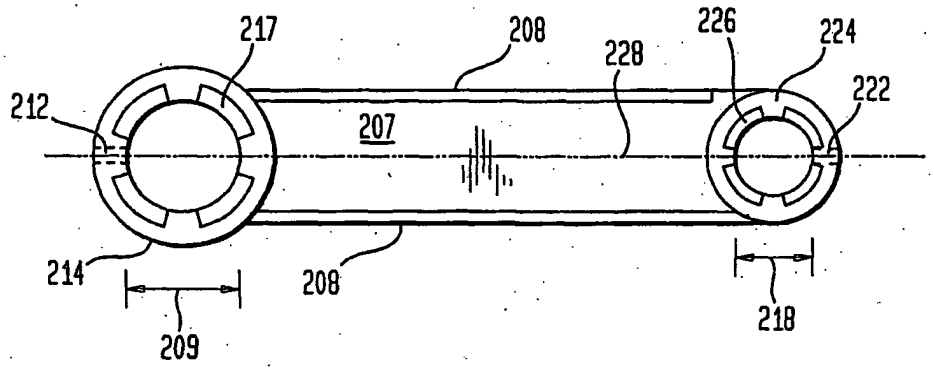


FIG. 13B

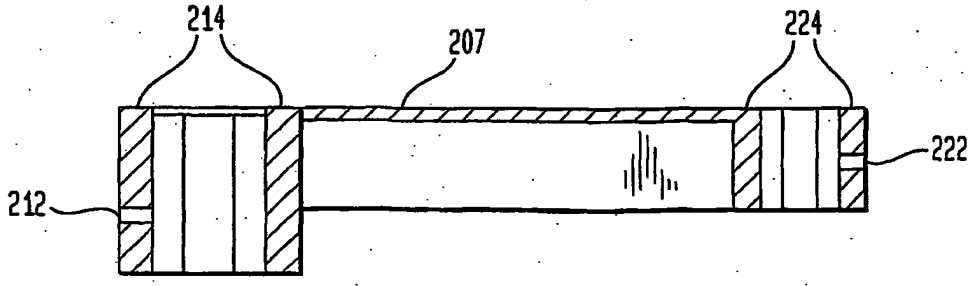


FIG. 14

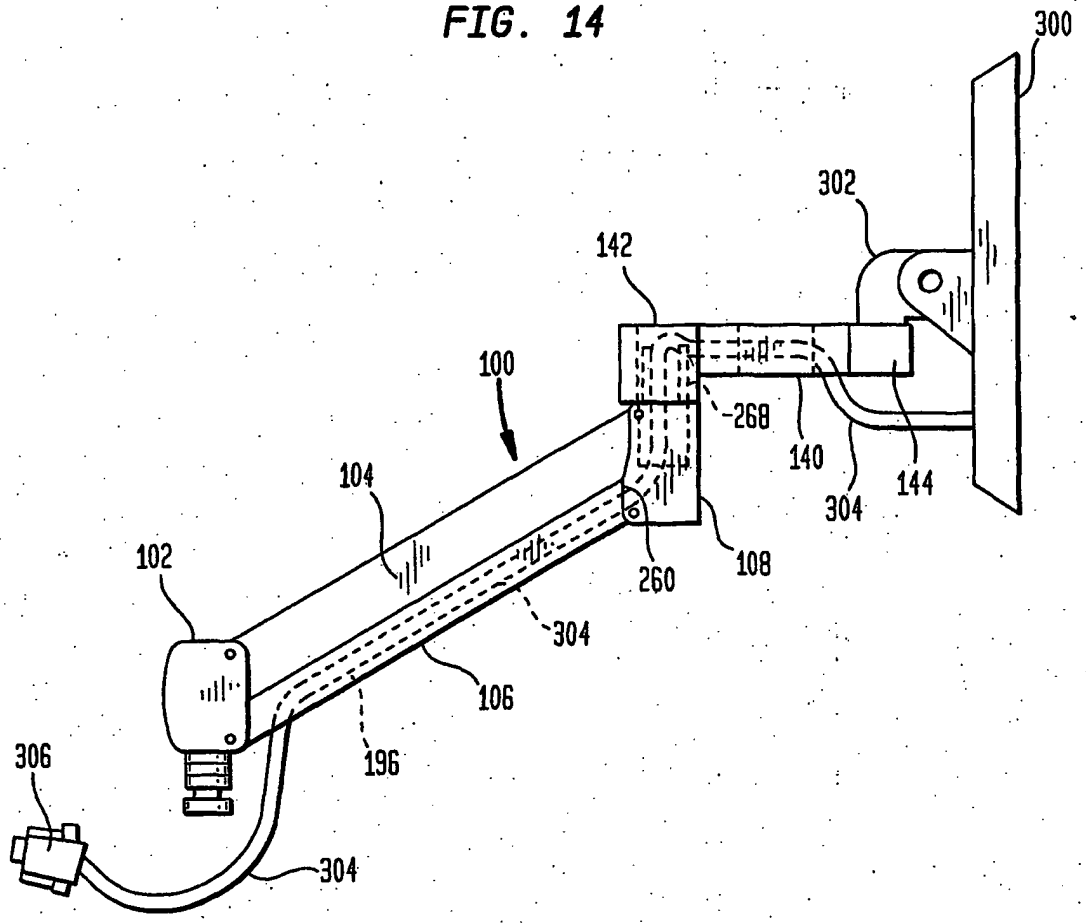


FIG. 15

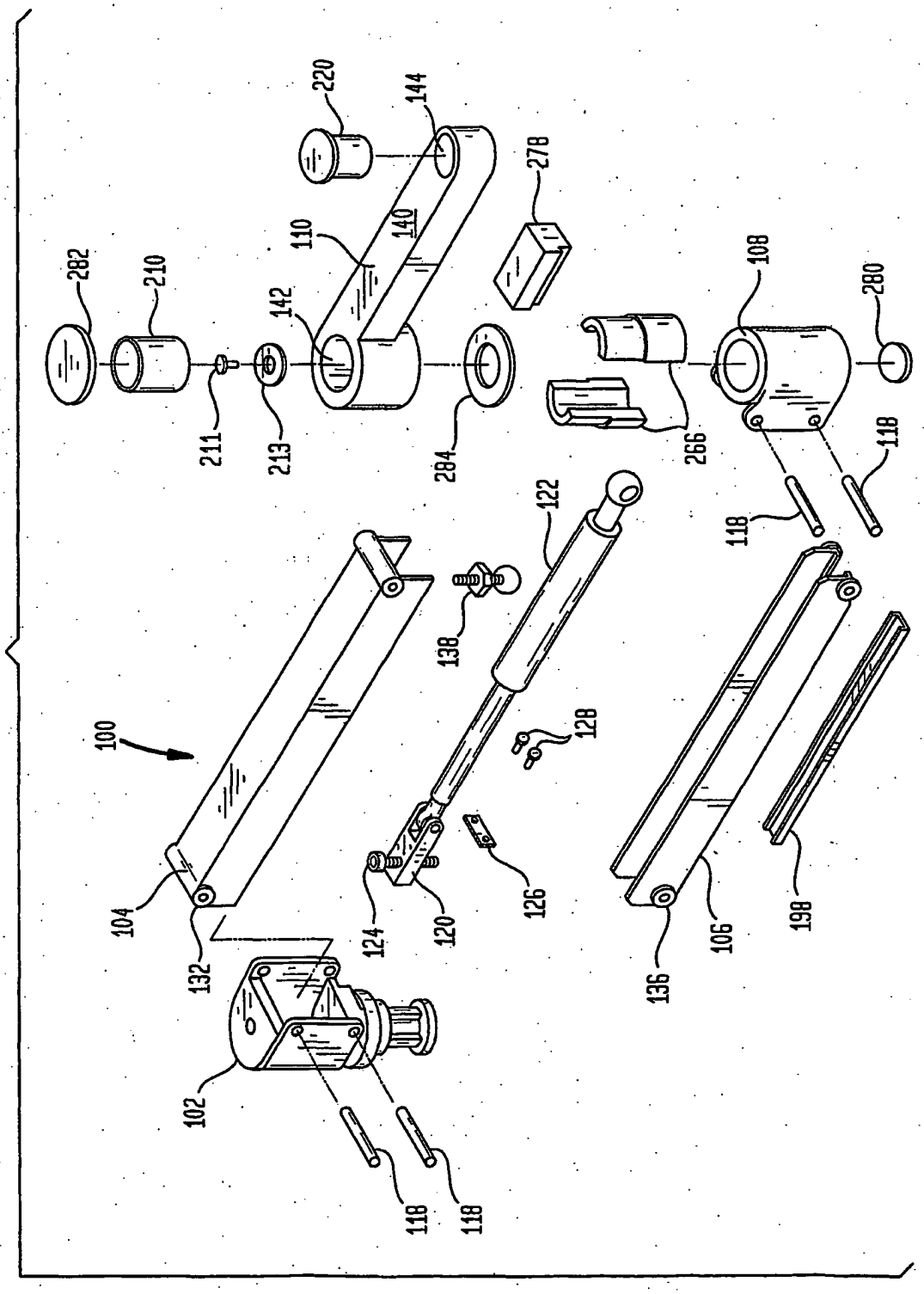


FIG. 16

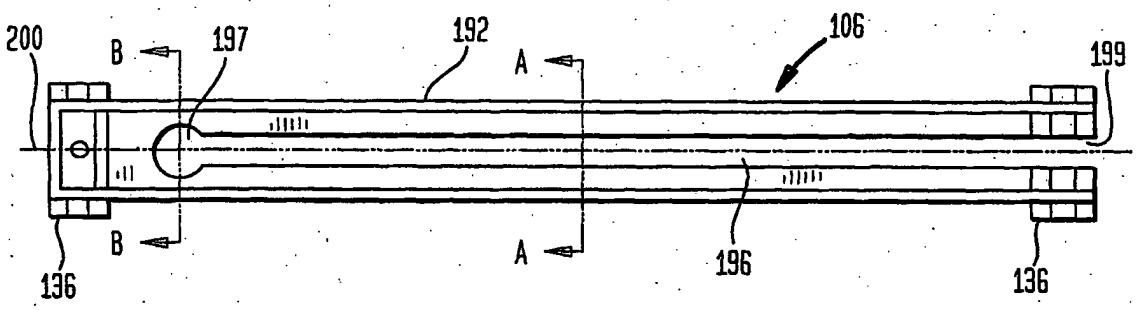


FIG. 17A

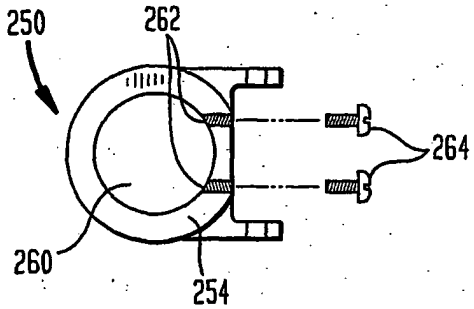


FIG. 17B

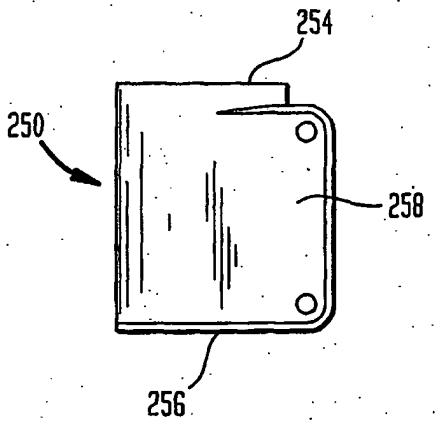


FIG. 17C

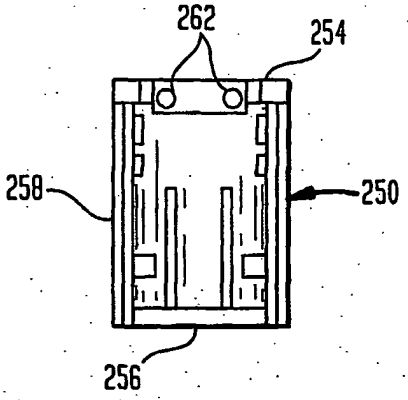


FIG. 18A

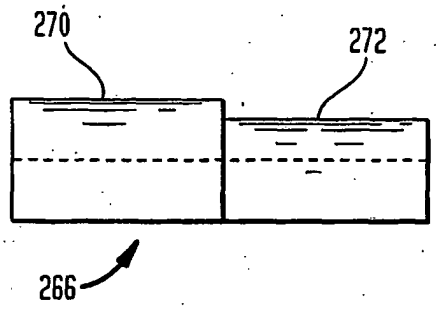


FIG. 18B

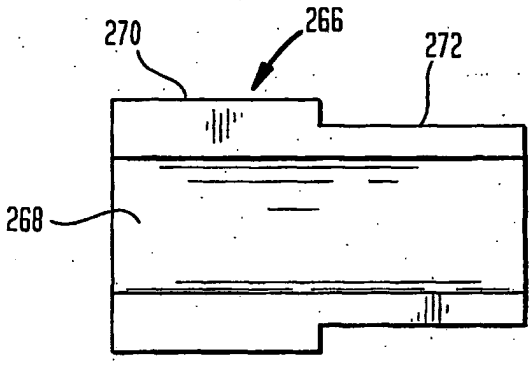


FIG. 18C

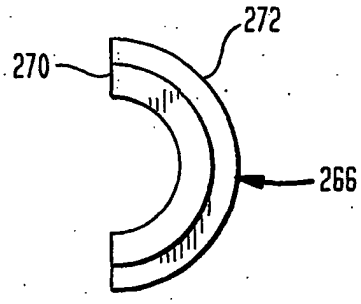


FIG. 19

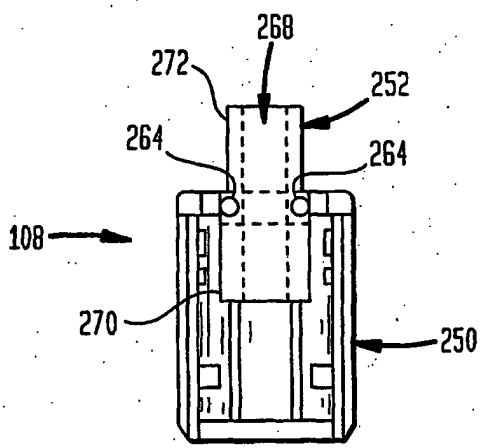


FIG. 20A

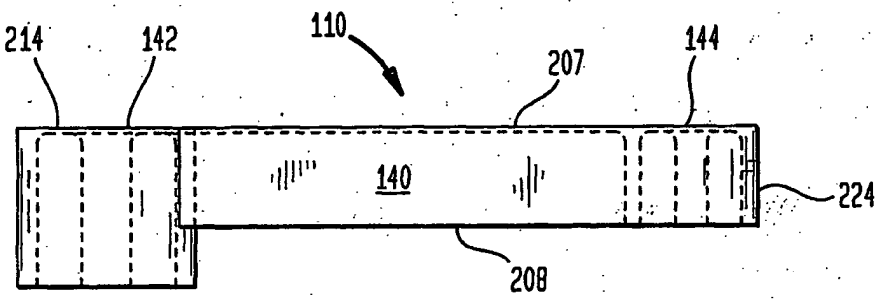


FIG. 20B

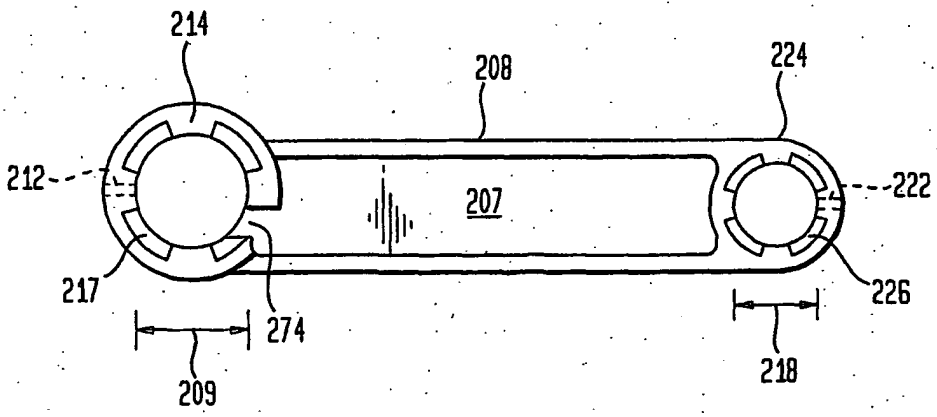


FIG. 21A

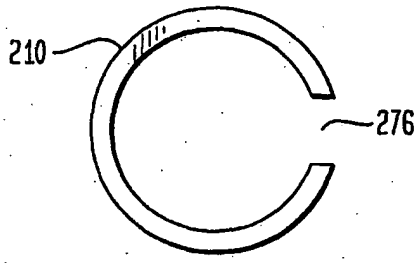
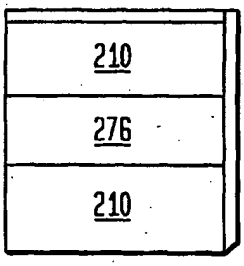


FIG. 21B



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09/406,006	24 September 1999 (24.09.1999)	US
09/405,628	24 September 1999 (24.09.1999)	US
60/191,266	22 March 2000 (22.03.2000)	US

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(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

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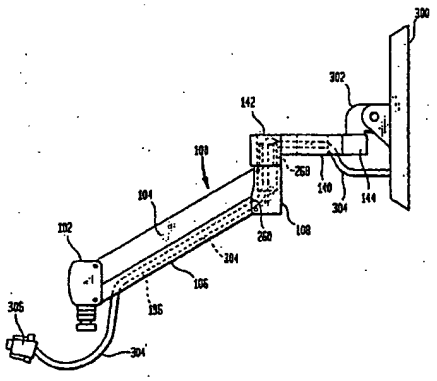
For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: ARM APPARATUS FOR MOUNTING ELECTRONIC DEVICES



(57) Abstract: An extension arm (100) suitable for mounting a flat-screen electronic peripheral device, such as a computer monitor or television, comprises a forearm extension (110) that has at one end a first coupling for attachment to a tilter, a platform or other means for supporting a flat-screen device and at the other end a second coupling with a slot formed therein. The extension arm (100) comprises a pair of endcaps (102, 108), upper channel (104) and a lower channel (106). The upper and lower channel and the endcaps form an adjustable parallelogram which is retained by a gas spring (122). The gas spring is attached at a first end to a ball stud mounted in the upper channel (104) and adjustably mounted at a second end to the first endcap (102).

WO 00/073027 A3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US00/12594

A. CLASSIFICATION OF SUBJECT MATTER

IPC(7) :E04G 3/00
US CL :248/282.1

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 248/282.1, 162.1, 364, 282.1, 280.11, 283.1, 289.11, 123.11, 325, 648

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X — Y	US 4,821,159 A (PIKE) 11 April 1989, see entire document, especially figure 1.	113,115, 116,118 --- 114,117, 119,120
A	US 4,852,842 A (O'NEILL) 01 August 1989, see entire document.	1-28, 82-94, 113-120
A	US 5,584,596 A (GREENE) 17 December 1996, see entire document.	1-28, 82-94, 113-120
A	US 5,743,503 A (VOELLER et al) 28 April 1998, see entire document.	1-28, 82-94, 113-120
A	US 6,076,785 A (ODDSEN, JR.) 20 June 2000, see entire document.	1-28, 82-94, 113-120

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search 06 OCTOBER 2000	Date of mailing of the international search report 16 OCT 2000
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer GWENDOLYN BAXTER Telephone No. (703) 308-2168

Form PCT/ISA/210 (second sheet) (July 1998)★

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US00/12594

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This international report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

Please See Extra Sheet.

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:
1-28, 82-94, 113-120

Remark on Protest
☐ The additional search fees were accompanied by the applicant's protest.
☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US00/12594

BOX II. OBSERVATIONS WHERE UNITY OF INVENTION WAS LACKING
This ISA found multiple inventions as follows:

This application contains the following inventions or groups of inventions which are not so linked as to form a single inventive concept under PCT Rule 13.1. In order for all inventions to be searched, the appropriate additional search fees must be paid.

Group I, claims 1-28, 82-94 and 113-120, drawn to an extension arm.
Group II, claims 29-39, 95-107 , drawn to endcaps.
Group III, claims 40-46, drawn to an upper channel.
Group IV, claims 47-52 and 108-112, drawn to a lower channel.
Group V, claims 53-69, drawn to a method of forming the extension arm.
Group VI, claims 70-75, drawn to a method of forming endcaps.
Group VII, claims 76-81, drawn to a method of forming channels.
The inventions listed as Groups I-VII do not relate to a single inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons: the special feature of each of the above groupings are distinctly claimed therein.